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Age Differences in the Prevalence of Physical Aggression Among 5–11-Year-Old Canadian Boys and Girls

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It has been proven extremely difficult in the past to estimate the prevalence of physical aggression in children for two main reasons: (a) a heterogeneous sampling of behaviors (i.e., mix between physically aggressive and non-physically aggressive antisocial behaviors), and (b) a lack of a "gold standard" to identify children who exhibit physically aggressive behaviors on a frequent basis. The goal of this study was to test for age differences in the prevalence of physical aggression in the Canadian population of school-aged boys and girls, using cross-sectional data from the National Longitudinal Survey of Children and Youth (NLSCY). The first wave of the NLSCY included a representative sample of 12,292 Canadian children aged 5–11 years. We used latent class analysis to identify children whose propensity to exhibit physically aggressive behaviors was much higher than that of other children of the same age and sex in the population. The prevalence of physical aggression was estimated at 3.7% in 5–11-year-old boys and ranged from .5% to 2.3% in 11 and 5-year-old girls, respectively. Hence, the results show a decreasing trend in the prevalence of physical aggression with age for girls, but not for boys. These findings suggest the importance of considering the developmental pathways of physical aggression for boys and girls separately. Aggr. Behav. 33:26–37, 2007. © 2006 Wiley-Liss; Inc.

Keywords: physical aggression; National Longitudinal Survey of Children and Youth; age differences; school-aged children; latent class analysis

INTRODUCTION

Physical aggression is recognized as one of the most serious forms of antisocial behavior. A number of longitudinal studies show that physical aggression leads to long-term consequences, such as scholastic difficulties, violent crimes, partner assault, alcoholism, drug abuse, unemployment, divorce, abusive parenting, and mental health disorder [Farrington, 1994; Fergusson and Horwood, 1998; Huesmann et al., 1984; Kokko and Pulkkinen, 2000; Nagin and Tremblay, 1999; Reiss and Roth, 1993; Serbin et al., 1998; Stattin and Magnusson, 1989; Woodward and Fergusson, 2000]. Although our society usually focuses on adolescent violence, several studies clearly show that children who are highly aggressive during the elementary school years are at greatest risk of physical violence during adolescence and adulthood [Broidy et al., 2003; Farrington et al., 1990; Nagin and Tremblay, 1999]. Furthermore, when present before the age

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of 10 years, physical aggression can lead to more serious psychosocial and academic impairment than later onset [Lahey et al., 1998; Moffitt, 1993].

Considering the serious consequences of childhood physical aggression, knowledge of its prevalence in the population is of great importance. Age and gender differences in the prevalence of physical aggression are among the most fundamental epidemiological questions. This information can help clarify the etiology, consequences, and continuity/discontinuity processes of physical aggression throughout the life span [Cohen et al., 1993; Maughan and Rutter, 1998; Rutter, 1988]. According to the arrested socialization hypothesis [Patterson, 1982; Tremblay, 2000, 2003], as children grow older, they learn not to aggress, with aggressive behavior being normative for younger children, but not for older ones. In addition, socialization pressures are often believed to be gender-differentiated [Fagot, 1984; Fagot and Hagan, 1985], with socializing agents selectively discouraging non-sex-type behaviors (e.g., physical aggression in girls) and encouraging girls to use empathic and prosocial behaviors to resolve conflict among peers [Keenan and Shaw, 1997; White, 2001]. In addition, girls may refrain from exhibiting physically aggressive behaviors to avoid self-criticism and maintain self-worth as they come to apply gender-stereotypic standards to regulate their own behaviors [Bussey and Bandura, 1999; Maccoby, 2002]. Hence, at least from a social-learning approach, we expect age differences in the prevalence of physical aggression; with a greater proportion of young children exhibiting physically aggressive behaviors on a frequent basis (see below for an operational definition of the prevalence of physical aggression). Moreover, we expect greater age differences in the prevalence of physical aggression among girls than boys.

Much of our knowledge on the prevalence of physical aggression comes from several epidemiological studies on conduct disorder (CD). CD is characterized by "…a repetitive and persistent pattern of behavior in which the basic rights of others or major age-appropriate societal norms or rules are violated …(p. 85) [APA, 1994]. Essentially, two types of symptoms are considered; namely, physically aggressive behaviors and non-physically aggressive antisocial behaviors that do not involve direct confrontation (e.g., theft, fraud, property destruction). Table I presents a summary of these studies. The few studies that reported on age differences in the prevalence of CD provide inconsistent findings. For example, Velez et al. [1989] found that the prevalence of CD was higher among children than adolescents. Similarly, Cohen et al. [1993] reported a higher prevalence of CD among children as compared to adolescents, but only for males. In contrast, other studies showed a higher prevalence of CD in older age groups than in younger age groups [Boyle et al., 1993; Esser et al., 1990; Offord et al., 1987, 1991]. Similarly, Loeber et al. [1998] reported a higher prevalence of CD among early adolescents compared to children, but only for boys. Meanwhile, three other studies found no significant age differences in the prevalence of CD [Breton et al., 1999; Fombonne, 1994; Offord and Lipman, 1996].

One factor that may explain these discrepant findings is that none of these studies distinguished between physically aggressive and non-physically aggressive antisocial behaviors. As noted by many researchers, it may be that physically aggressive behaviors are more common in early childhood, whereas non-physically aggressive antisocial behaviors occur more frequently during later childhood and early-to-mid adolescence [e.g., Lahey et al., 1999; Loeber and Hay, 1997; Loeber et al., 2000; Mezzacappa and Earls, 1998; Quay, 1999]. The results coming out of three epidemiological studies suggest that there is a decreasing trend in physical aggression with age, but these studies have serious limitations. In one study, Tremblay et al. [1996] analyzed data for 4–11-year-old children from the first wave of the National Longitudinal Survey of Children and Youth (NLSCY). They found a higher mean frequency of physically aggressive behaviors among younger children. They did not, however, distinguish between children who exhibit physically aggressive behaviors only occasionally and those who do so frequently. It is extremely important to do so for several reasons. While there are a relatively large number of children who occasionally exhibit physically aggressive behaviors, there are a much smaller number of them who do so on a frequent basis, suggesting that it is only in the latter case that we are in the presence of a real problem. This is true even before children enter school at a time when disruptive behaviors are generally considered to be quite common in the general population [Campbell, 1990]. Using the data from the first wave of the NLSCY, Baillargeon et al. [2005] estimated that 37.7% of 2-year-old boys and 33.1% of 2-year-old girls kick, bite, and hit other children sometimes; in contrast, only 4.8% of boys and 2.4% of girls were estimated to exhibit this behavior often. There is at least one other reason for distinguishing between occasional and frequent aggressive behavior. There

TABLE I. Prevalence of Conduct Disorder and Aggressiveness in Different Countries (Overview)

Study	Country (area)	*N*	Sample	Age (in years)	Diagnostic system (method)	Prevalence
			Netherlands			
Verhulst et al. (1990)	(Zuid-Holland) (G)	933	Screened Dutch nationality (G)	10–11	Achenbach Child Behavior Checklist (cutoffs)	(P)
	International (A)	2,148	Screened birth cohort (A)	12–15		(G) 10–11 yr; 1.9% (boys), 1.8% (girls) 12–15 yr; 2.0% (boys), 1.9% (girls) (A) 10–11 yr; 2.9% (boys), 1.6% (girls) 12–15 yr; 2.8% (boys), 3.3% (girls)
			Germany			
Esser et al. (1990)	(Mannheim)	216	Household sample	8	ICD-9 (clinician; distress or social impairment)	Time 1 (P)
				13		.9%; 1.9% (boys), 0% (girls) Time 2 (C,P) 5.8%; 6.0% (boys), 5.0% (girls)
			France			
Fombonne (1994)	(Chartres)	2,441	Screened school based sample	8–9	ICD-9 (clinician; distress or social impairment; CGAS < 61)	(P,T)
				10–11		7.4% (8–9 yr), 5.3% (10–11 yr) 9.3% (boys), 3.2% (girls)
			New Zealand			
McGee et al. (1992)	(Dunedin)	1,901	Birth cohort (Queen Mary Hospital)	11	DSM-III (algorithm)	(C,P) Aggressive CD
				15		1.6% (11 yr), 1.3% (15 yr)
			Sudan			
Rahim and Cederblad (1984)	(Khartoum North town)	3,878 (3–6 yr) 5,184 (7–15 yr)	Household sample	3–6	Rutter scale (clinician; distress or social impairment)	Aggressiveness (P) 3–6 yr: 21.3% (24.5% for boys; 18.6% for girls) 7–15 yr: 9.8% (16.0% for boys; 1.9% for girls)
				7–15		
			USA			
Velez et al. (1989)	(Saratoga and Albany counties, NY)	776	Household sample	9–12 13–18 11–14 15–20	DSM-III-R (algorithm)	(C,P) 9–12 yr—11.9% 13–18 yr—11.6% 11–14 yr—10.9% 15–20 yr—9.9%
Cohen et al. (1993)	(Saratoga and Albany counties, NY)	1,495	Household sample	10–13	DSM-III-R (algorithm)	(C, P) Boys—16.0% (10–13 yr), 15.8%
				14–16 17–20		(14–16 yr), 9.5% (17–20 yr) Girls—3.8% (10–13 yr), 9.2% (14–16 yr), 7.1% (17–20 yr)
Loeber et al. (1998)	(Pittsburgh)	1,517	Household sample (boys only)	7, 11, 13	DSM-III-R (algorithm)	(C,P) 5.6% (7 yr), 5.4% (11 yr), 8.3% (13 yr)
			Canada			
Offord et al. (1987)	(Ontario)	2,769	Household sample	4–11	DSM-III (threshold score; distress or social impairment)	(P,T,C) 5.5%/8.1% (boys), 2.7% (girls)
				12–16		4–11 yr—6.5% (boys), 1.8% (girls) 12–16 yr—10.4% (boys), 4.1% (girls)

TABLE I. Continued

Study	Country (area)	*N*	Sample	Age (in years)	Diagnostic system (method)	Prevalence
Boyle et al. (1993)	(Ontario)	251	Screened school-based sample (public; urban area)	6–11	DSM-III-R (algorithm)	(P) .4% (6–11 yr), 3.4% (12–16 yr)
				12–16		(C) 1.0% (6–11 yr), 1.8% (12–16 yr)
Boyle et al. (1996)	(Ontario)	251	Screened school-based sample (public; urban area)	6–16	DSM-III-R (algorithm)	(P) 1.0% (6–16 yr)
		114		6–11	DSM-III-R (clinician)	(T) 1.6% (6–11 yr)
Offord and Lipman (1996)	(Canada)	22,831	Household sample	4–7	DSM-IV (threshold score)	(P) 4–7 yr; 9.5%; 10.6% (boys), 8.3% (girls)
				8–11		8–11 yr 9.8%; 11.3% (boys), 8.2% (girls)
Breton et al. (1999)	(Quebec)	2,400	Household sample	6–8	DSM-III-R (algorithm)	(P,T,C) 2.0% (C); .7% (T); .4 (P)
				9–11		6–8 yr; 1.9% (C); .7% (T); .2 (P)
				12–14		9–11 yr; 1.9% (C); .6% (T); .5 (P)
						12–14 yr; 2.3% (C); 0% (T); .6 (P)

Note: C = child, P = parent, T = teacher informant; Algorithm = computer algorithm, Threshold score = optimal cut scores on questionnaires set by reference to clinician diagnoses; G = General population, A = Adopted children.

may be age differences in physically aggressive behaviors when they are exhibited occasionally, but not when exhibited on a frequent basis, or vice versa. For example, Baillargeon et al. [2005] found that 3-year-old children were less likely than 2-year-old children to kick, bite, and hit other children sometimes rather than not at all, but they found no age differences in the odds of exhibiting this behavior often rather than sometimes. Another problem associated with testing for age differences in the mean frequency of physically aggressive behaviors is that one may find no age differences when in fact the proportion of physically aggressive children does vary across age groups [Thissen et al., 1986]. The converse is also true. For instance, one may find that the mean frequency of physically aggressive behaviors is smaller among older children if the likelihood of exhibiting some of these behaviors such as biting other children is decreasing with age among physically aggressive children even though the proportion of these children does not vary across age groups.

The other two epidemiological studies on physical aggression revealed a similar trend, but have important limitations as well, since they compared only two rather broadly defined age groups. McGee et al. [1992] found the prevalence of physical aggression to be higher at age 11 than at age 15. Similarly, Rahim and Cederblad [1984] found a higher prevalence of physical aggression among 3–6-year-old children than among children aged 7–15 years.

Similar results have also been reported in non-epidemiological studies of physical aggression. For instance, Cairns et al. [1989] found that the mean frequency of physically aggressive behaviors was decreasing from 10 to 18 years of age among North Carolina children. In the Pittsburgh youth study, Loeber and Smith [1996] found a decrease in the mean frequency of boys' physically aggressive behaviors between 6 and 17 years of age according to parent reports. Tremblay et al. [1999] reported a similar developmental trend with a large sample ($N = 1{,}037$) of males (6–15 years of age) of low socioeconomic status. It is difficult to know, however, the extent to which these results can be generalized to the population, and beside all these studies relied on the mean frequency of aggressive behaviors.

Is it possible to distinguish between children who exhibit physically aggressive behaviors on a frequent

basis and those who do so only occasionally or not at all? This issue and the one of age differences in the prevalence of physical aggression among 5–11-year-old boys and girls will be investigated by re-analyzing the data from the first wave of the NLSCY. In this study, a logit-based latent class model [Hagenaars, 1993] will be used to identify qualitatively different types of children who differ markedly in their propensity to exhibit physically aggressive behaviors. Within this framework, the prevalence of physical aggression can be operationally defined as the proportion of children whose propensity to exhibit physically aggressive behaviors is much higher than that of other children of the same age and sex. Furthermore, this model allows for testing age differences in the prevalence of physical aggression. Unlike a previous attempt to analyze these data [Tremblay et al., 1996], we will test for the presence of age differences in physical aggression beyond those that may exist in the likelihood of exhibiting some physically aggressive behaviors (e.g., biting) among physically aggressive children.

METHOD

Participants

The NLSCY is the first Canadian nation-wide household survey [Human Resources and Skills Development Canada & Statistics Canada, 1996]. It is being conducted by Human Resources and Skills Development Canada and Statistics Canada. Children living in institutions (i.e., hospitals, residential facilities where the child has lived for more than 6 months) and Aboriginal reserves were not targeted by the survey. (Note that data from the Yukon and the Northwest Territories are not considered in this paper.) The sociodemographic characteristics of these children and their families have been described previously by Ross et al. [1996].

In total, 15,579 households that included at least one child aged 0–11 years were selected to participate in the first data collection cycle of the NLSCY (1994–1995). A complete face-to-face or telephone interview was obtained for 13,443 households for an overall response rate of 86.3%. These responding households represented 81.4% of the total number of Canadian households estimated to have children aged 0–11 years. A maximum of four children living in a selected household were selected to participate, for a total of 22,831 children aged 0–11 years. Of these, 12,292 ranged in age from 5 to 11 years. There were approximately 1,800 children per age group, half boys and half girls.

Instrument

Three behavior items were used to assess children's physical aggression: (a) gets into many fights? (b) physically attacks people? (c) kicks, bites, or hits other children? Note that these behaviors relate exclusively to physical aggression and not to other types of antisocial disturbance such as oppositional behaviors (e.g., disobedience, spiteful, or vindictive). These behavior items were part of a children's questionnaire administered via computer-assisted interviewing that took place between fall 1994 and spring 1995. Each behavior item was rated by the Person Most Knowledgeable (PMK) about the child—usually the mother—using a three-point Likert scale: never or not true (1), sometimes or somewhat true (2), and often or very true (3). The reliability of this set of three behavior items was remarkably high. The reliability coefficient estimates varied from .87 to .99 and from .88 to .95 for 5–11-year-old boys and girls, respectively, suggesting that the error-score variance in the data is small relative to the observed-score variance.

Statistical Method

Latent class analysis provides an empirical means to identify a set of mutually exclusive and exhaustive latent classes of individuals that account for the distribution of responses to a set of manifest discrete variables—behavior items [Hagenaars and McCutcheon, 2002]. The basic assumption of latent class analysis is that within any single latent class, the manifest variables are independent of one another (i.e., the assumption of local independence). Thus, the association among the manifest variables results from the differences between the two or more latent classes. Each individual is assumed to be in one, and only one, of the latent classes.

We estimated three kinds of parameters. First, the unconditional probability that a randomly selected boy and girl in the population belongs to a given latent class. Second, the conditional probability of a rating in a rating category for a particular behavior item given the child's latent class. Note that these parameters were estimated simultaneously for boys and girls in the different age groups. Hence, the likelihood of exhibiting a particular behavior item (e.g., biting) among boys and girls belonging to a given latent class was allowed to vary from one age group to another. Third, the younger/older adjacent

age groups ratio of the odds of being physically aggressive.

Maximum Likelihood Estimation

Maximum likelihood parameter estimates for the various latent class models considered in this study were obtained using the Expectation Maximization (EM) algorithm from a computer program for the analysis of categorical data written by Vermunt [1997]. This program is called LEM (Log-linear and event history analysis with missing data using the EM algorithm). The EM algorithm was run at least 100 times using different starting values. Each time the iterations were stopped when a convergence criterion was reached (i.e., the minimum increase in the log-likelihood function between subsequent iterations was set at .0000000000000001). This was done to ensure that the maximum likelihood estimates represent a global rather than local maximum [McCutcheon, 1987]. In a clustered sample such as the NLSCY, each child is assigned a weight that represents the number of children in the population that she/he represents. We divided each weight by the mean of the weights for children of the same age and sex to get proper estimates of the standard error of our estimates. We then eliminated cases with missing values on any of the three behavior items used to assess physical aggression. However, very few cases (i.e., less than 3%) were eliminated for that reason, with the majority of them having missing data on all three behavior items.

The goodness-of-fit of a particular latent class model was assessed using the Pearson (X^2) and the likelihood-ratio (L^2) χ^2 (chi-square test) statistics. Both tests have a large sample χ^2 distribution under certain conditions [see Clogg, 1979]. Because the third rating category (i.e., often or very true) was generally endorsed by less than 6% of the PMKs—creating relatively sparse multidimentional tables—the asymptotic suitability of the χ^2 distribution for the X^2 and the L^2 test statistics was a particular concern in our analysis [Fienberg, 1980]. For that reason, we estimated the actual P values associated with the L^2 and X^2 using 1,000 bootstrap samples using an experimental version of LEM that implements the parametric bootstrap [Langeheine et al., 1996]. Essentially, this technique provides a way of estimating the empirical distribution of the X^2 and L^2 from the data at hand. We used the Bayesian Information Criterion [BIC; L^2-(df)(natural logarithm)] to compare competing models, the model with the smallest value being preferred. We used a conservative alpha level (i.e., .01) because our variance estimates are likely to be underestimates of the ones than we would have obtained with a simple random sample.

RESULTS

Table II presents the goodness-of-fit test statistics for the various latent class models considered in this study. First, we considered an unrestricted one-class model. This model assumes that the behavior items are statistically independent. The one-class model did not provide an acceptable fit to the data, suggesting that elementary school-aged boys and girls differ in their propensity to exhibit physically aggressive behaviors (see Table II). Next, we considered an unrestricted two-class model. This model assumes that physical aggression in children is either present or absent. The two-class model did not provide an acceptable fit to the data, except for 8-year-old girls, where it was satisfactory according to both the L^2 and the X^2 test statistics (see Table II). These results led us to consider an unrestricted three-class model. This model assumes that the PMKs' ratings on the three behavior items can be explained by a latent physical aggression variable, made up of three latent classes of children. The three-class model provided an acceptable fit to the data according to both the L^2 and the X^2 test statistics, except for 6-year-old children (see Table II). In the case of 6-year-old boys, there were no standardized residuals—the difference between the observed and expected frequency divided by the standard error of the latter—greater than 2.58 in absolute value. This was also the case for the other age groups where the three-class model provided an acceptable fit to the data, except for 7-year-old boys where there was one standardized residual greater than 2.58 in absolute value. In addition, the three-class model accounted for a great deal of the variance in the PMK's ratings on the three behavior items (see Table II). This can be evaluated by comparing the one-class wih the three-class model. For instance, the three-class model accounted for 97% (i.e., $[1-(13.67/459.38) = .97]$ and 99% $[1-(1.49/273.46) = .99]$ of the variance in the data for 5-year-old boys and girls, respectively (see Table II). Overall, the three-class model seems to provide an acceptable fit to the data.[1]

Table III gives the estimates for the conditional probability of a randomly selected boy and girl in the Canadian population of 5–11-year-old children

[1]Note that a four-class model is not identifiable with the data [McCutcheon, 1987].

TABLE II. Pearson and Likelihood-ratio Chi-Square Statistics for Some Latent Class Models for Physical Aggression

	Pearson chi-square (χ^2)		*P*		Likelihood-ratio chi-square (L^2)		*P*		Degrees of freedom		BIC		% of variance	
Model	B	G	B	G	B	G	B	G	B	G	B	G	B	G
5-year-old (N = 889/858)														
One-class	1,080.67	7,188.99	.00	.00	459.38	273.46	.00	.00	20	20	323.58	138.35		
Unrestricted two-class	75.39	413.75	.00	.00	50.47	9.62	.00	.18	13	13	−37.80	−78.19	89.01	96.48
Unrestricted three-class	11.54	1.26	.15	.32	13.67	1.49	.13	.28	6	6	−27.07	−39.04	97.02	99.46
6-year-old (N = 931/828)														
One-class	2,373.66	13,543.7	.00	.00	463.58	368.40	.00	.00	20	20	326.85	234.01		
Unrestricted two-class	105.52	375.54	.00	.00	68.33	41.75	.00	.00	13	13	−20.55	−45.60	85.26	88.67
Unrestricted three-class	19.70	17.05	.02	.03	23.88	13.64	.004	.007	6	6	−17.14	−26.68	94.85	96.30
7-year-old (N = 839/877)														
One-class	910.50	5,527.58	.00	.00	369.84	256.73	.00	.00	20	20	235.20	121.20		
Unrestricted two-class	37.79	97.70	.02	.005	32.79	14.86	.003	.10	13	13	−54.72	−73.24	91.13	94.21
Unrestricted three-class	18.95	7.69	.04	.11	15.89	4.89	.02	.34	6	6	−24.50	−35.78	95.70	98.10
8-year-old (N = 876/873)														
One-class	1,275.93	816.65	.00	.00	537.84	286.74	.00	.00	20	20	402.34	151.30		
Unrestricted two-class	39.40	20.59	.007	.14	34.45	22.79	.00	.03	13	13	−53.63	−65.24	93.59	92.05
Unrestricted three-class	5.88	11.43	.64	.28	8.59	11.55	.42	.26	6	6	−32.06	−29.08	98.40	95.97
9-year-old (N = 878/820)														
One-class	3,897.88	939.78	.00	.00	442.04	212.21	.00	.00	20	20	306.49	78.03		
Unrestricted two-class	149.00	132.24	.00	.003	46.02	16.97	.00	.03	13	13	−42.09	−70.25	89.59	92.00
Unrestricted three-class	6.26	4.66	.37	.03	7.64	4.50	.32	.06	6	6	−33.03	−35.75	98.27	97.88
10-year-old (N = 895/853)														
One-class	1,948.50	13,799.7	.00	.00	382.39	382.80	.00	.00	20	20	246.50	246.46		
Unrestricted two-class	63.99	172.04	.003	.00	37.93	45.69	.00	.00	13	13	−50.43	−42.05	90.08	88.06
Unrestricted three-class	7.68	4.97	.54	.39	9.99	5.16	.39	.38	6	6	−30.79	−35.33	97.39	98.65
11-year-old (N = 837/815)														
One-class	4,556.44	7,275.56	.00	.00	344.19	200.74	.00	.00	20	20	209.60	66.68		
Unrestricted two-class	167.09	180.77	.00	.005	52.48	15.35	.00	.05	13	13	−35.00	−71.79	84.75	92.35
Unrestricted three-class	4.57	.27	.69	.85	5.14	.38	.66	.81	6	6	−35.24	−39.85	98.51	99.81

Note: Numbers in parentheses refer to the number of boys (before the slash) and girls with no missing data on all three behavior items. B = boys, G = girls; BIC = Bayesian Information Criterion.

being rated in a particular category given his/her latent class membership under the preferred three class model (presented below). This model allows distinguishing between children who tend to exhibit physically aggressive behaviors on a frequent basis and those who tend to do so only occasionally, which we shall refer to as high- and medium-aggressive, respectively. Consider the odds of fighting often rather than sometimes for 7-year-old boys. The odds were (.82/.18) = 4.56 for members of the high-aggressive latent class; comparatively, the odds were only (.06/.82) = .07 for members of the medium-aggressive latent class (see Table III). Hence, the odds of fighting often rather than sometimes were (4.56/.07) = 65.14 times higher for high- than for medium-aggressive 7-year-old boys. Note that a very similar pattern was observed for the other behavior items and for girls. In addition, this model allows distinguishing between children who tend to exhibit physically aggressive behaviors on an occasional basis and those who tend not to exhibit the behaviors in question. We shall refer to these latter children as low-aggressive. Consider the odds of fighting sometimes rather than never for 7-year-old boys. The odds were (.82/.12) = 6.83 for members of the medium-aggressive latent class; comparatively, the odds were only (.21/.77) = .27 for members of the low-aggressive latent class (see Table III). Hence, the odds of fighting sometimes rather than never were (6.83/.27) = 25.30 times higher for medium- than for low-aggressive 7-year-old boys. Note that a very similar pattern was observed for the other behavior items and for girls. Hence, these results suggest that it is possible to distinguish between children who exhibit physically aggressive behaviors on a frequent basis and those who do so only occasionally or not at all.

Age Differences in the Prevalence of Physical Aggression Among Elementary School-Aged Boys and Girls

Are there age differences in the proportion of 5 to 11-year-old boys and girls in the general

population who tend to exhibit physically aggressive behaviors on a frequent basis? To answer this question, we considered a null association model separately for boys and girls. This model assumes that there is no association between the latent physical aggression variable and age beyond that expected by chance alone. Under this model, the proportion of boys and girls who belong to the low-, medium- and high-aggressive latent classes does not vary from one age group to another. The null association model represented a statistically significant increase in L^2 from the unrestricted three-class model for girls ($L^2 = 69.65–41.61 = 28.04$; df = 54–42 = 12; $P = .006$), but not for boys ($L^2 = 102.83–84.81 = 18.03$; df = 54–42 = 12; $P = .12$).[2] Moreover, for boys, this model had a smaller BIC than the unrestricted three-class model. (The null association model is therefore the preferred latent class model for boys.)

On the one hand, these results suggest that there are no age differences in the prevalence of physical aggression for boys. In fact, the unconditional probability of a randomly selected 5–11-year-old boy in the Canadian population belonging to the low-, medium-, and high-aggressive latent class was estimated at .785, .178 and .037, respectively (see Table III). In other words, we estimated that 3.7% of 5–11-year-old boys tend to exhibit physically aggressive behaviors on a frequent basis.

On the other hand, these results suggest that there are age differences in the prevalence of physical aggression for girls. How best can we characterize these differences? To answer this question, we considered a uniform association model. This model assumes that the younger/older adjacent age groups ratio of the odds of being medium- rather than low-aggressive is equal to the younger/older adjacent age group ratio of the odds of being high- rather than medium-aggressive. Under this model, the proportion of high- and medium-aggressive girls is either decreasing or increasing with age. The uniform association model yielded a L^2 (X^2) of 53.66 (69.39) with 53 degrees of freedom (P (L^2) = .10; P (X^2) = .14). This does not represent a significant increase in L^2 relative to the increase in the degrees of freedom ($L^2 = 53.66–41.61 = 12.05$; df = 53–42 = 11; $P = .36$) from the unrestricted three-class model. Moreover, the BIC value associated with this model was smaller than the ones for the unrestricted three-class and null association models. (The uniform association model is therefore the preferred latent class model for girls.) The unconditional probability of a randomly selected 5–11-year-old girl in the Canadian population belonging to the low-, medium-, and high-aggressive latent class varied substantially across the different age groups (see Table III). While we estimated that 2.3% of 5-year-old girls tend to exhibit physically aggressive behaviors on a frequent basis, only .5% of 11-year-old girls were estimated to do so.

This decrease in the prevalence of physical aggression with age for girls can be best described in the following manner. For example, the odds of being high- rather than medium-aggressive were estimated to be 1.14 [99% confidence interval: 1.05–1.24] times lower among 6-year-old than 5-year-old girls; and, in addition, the odds of being high- rather than low-aggressive were 2.28 [i.e., exponential (2 × natural logarithm (1.14)] times lower among 6-year-old than 5-year-old girls. In turn, the odds of being high- rather than medium-aggressive were 1.14 times lower among 7-year-old than 6-year-old girls, and so on and so forth. Reported over the entire age distribution, this represented substantial age differences in the prevalence of physical aggression for girls. In fact, the odds of being high- rather than medium-aggressive were estimated to be 2.21 times lower among 11-year-old than 5-year-old girls; and, in addition, the odds of being high- rather than low-aggressive were 4.91 [i.e., exponential (2 × natural logarithm (2.21))] times lower among 11-year-old than 5-year-old girls.

DISCUSSION

The aim of this study was to test for age differences in the prevalence of physical aggression among elementary school-aged boys and girls in the general population. On the one hand, our results suggest that the prevalence of physical aggression in girls is decreasing with age. The development of aggressive behavior in girls during the elementary school years may be characterized by some form of "regression toward the mean" [Loeber, 1982], with more girls "drifting out of" than "drifting into" exhibiting physically aggressive behaviors on a frequent basis over time. One possible explanation is that parents and other socializing agents may discourage the use of physically aggressive behavior in girls [Coie and Dodge, 1998; Keenan and Shaw, 1997; Tremblay et al., 1999]. In addition, as they come to apply gender-stereotypic standards to regulate their own behaviors, girls may be shunning

[2] 41.61 and 84.81 refer to the sum of L^2 (presented in Table II) for the different age groups for girls and boys, respectively.

TABLE III. Parameter Estimates Under the Preferred Three-Class Model for Physical Aggression

Boy																							
	Latent class																						
	Low-aggressive							Medium-aggressive							High-aggressive								
Age (years):	5	6	7	8	9	10	11	5	6	7	8	9	10	11	5	6	7	8	9	10	11		
Unconditional probability estimate																							
	.785 (.009)	.785 (.009)	.785 (.009)	.785 (.009)	.785 (.009)	.785 (.009)	.785 (.009)	.178 (.01)	.178 (.01)	.178 (.01)	.178 (.01)	.178 (.01)	.178 (.01)	.178 (.01)	.037 (.005)	.037 (.005)	.037 (.005)	.037 (.005)	.037 (.005)	.037 (.005)	.037 (.005)		
Rating category																							
Conditional probability estimate for Kicks, bites, hits other children																							
1	.91 (.01)	.93 (.01)	.91 (.01)	.93 (.01)	.98 (.01	.96 (.01)	.97 (.01)	.22 (.04)	.34 (.05)	.41 (.06)	.33 (.05)	.35 (.06)	.54 (.06)	.50 (.06)	.46 (.12)	.18 (.09)	.02 (.06)	.00[a]	.00[a]	.00[a]	.06 (.08)		
2	.08 (.01)	.07 (.01)	.09 (.01)	.07 (.01)	.02 (.01)	.04 (.01)	.03 (.01)	.77 (.04)	.63 (.05)	.52 (.06)	.64 (.05)	.65 (.05)	.44 (.05)	.50 (.06)	.40 (.12)	.58 (.11)	.81 (.11)	.88 (.07)	.57 (.12)	.84 (.10)	.61 (.10)		
3	.01 (.004)	.00[a]	.0001(.001)	.00[a]	.00[a]	.00[a]	.00[a]	.002 (.01)	.03 (.01)	.06 (.03)	.03 (.02)	.00 (.01)	.02 (.01)	.00[a]	.14 (.07)	.24 (.09)	.17 (.09)	.12 (.07)	.43 (.12)	.16 (.10)	.33 (.09)		
Rating category																							
Conditional probability estimate for Physically attacks people																							
1	.96 (.01)	.98 (.01)	.95 (.01)	.95 (.01)	.94 (.01)	1.0 (.01)	.96 (.01)	.20 (.05)	.23 (.06)	.24 (.06)	.22 (.07)	.18 (.06)	.20 (.08)	.38 (.07)	.00[a]	.18 (.10)	.11 (.09)	.15 (.09)	.29 (.11)	.00 (.06)	.00[a]		
2	.04 (.01)	.02 (.01)	.05 (.01)	.05 (.01)	.06 (.01)	.004 (.01)	.03 (.01)	.78 (.05)	.77 (.06)	.75 (.06)	.77 (.07)	.75 (.06)	.81 (.08)	.62 (.07)	.76 (.09)	.33 (.14)	.70 (.12)	.52 (.12)	.32 (.13)	.61 (.13)	.69 (.09)		
3	.00[a]	.0003 (.001)	.00[a]	.00[a]	.00[a]	.0008(.001)	.002 (.001)	.03 (.01)	.007 (.01)	.01 (.001)	.01 (.01)	.08 (.03)	.00[a]	.00[a]	.24 (.09)	.48 (.12)	.20 (.09)	.34 (.10)	.40 (.12)	.39 (.12)	.31 (.09)		
Rating category																							
Conditional probability estimate for Gets into many fights																							
1	.75 (.02)	.76 (.02)	.77 (.02)	.75 (.02)	.78 (.02)	.76 (.02)	.79 (.02)	.10 (.04)	.15 (.05)	.12 (.05)	.07 (.05)	.16 (.05)	.29 (.05)	.25 (.06)	.19 (.14)	.35 (.11)	.00[a]	.22 (.14)	.01 (.02)	.17 (.10)	.02 (.03)		
2	.23 (.02)	.24 (.02)	.21 (.02)	.24 (.02)	.22 (.02)	.23 (.02)	.19 (.02)	.85 (.05)	.79 (.05)	.82 (.06)	.88 (.05)	.75 (.05)	.59 (.05)	.70 (.06)	.00[a]	.04 (.07)	.18 (.16)	.00 (.14)	.50 (.12)	.25 (.12)	.23 (.11)		
3	.02 (.006)	.002 (.002)	.03 (.007)	.01 (.004)	.003 (.003)	.02 (.006)	.02 (.006)	.05 (.04)	.06 (.03)	.06 (.04)	.04 (.03)	.09 (.03)	.12 (.04)	.06 (.04)	.81 (.14)	.61 (.12)	.82 (.16)	.78 (.15)	.49 (.12)	.58 (.12)	.76 (.11)		
Girl																							
Latent class																							
Age (years):	5	6	7	8	9	10	11	5	6	7	8	9	10	11	5	6	7	8	9	10	11		
Unconditional probability estimate																							
	.809 (.02)	.831 (.01)	.851 (.01)	.868 (.01)	.884 (.01)	.898 (.01)	.910 (.01)	.168 (.02)	.151 (.01)	.135 (.01)	.121 (.01)	.108 (.01)	.096 (.01)	.085 (.01)	.023 (.01)	.018 (.004)	.014 (.003)	.011 (.002)	.009 (.002)	.007 (.002)	.005 (.001)		
Rating Category																							
Conditional probability estimate for Kicks, bites, hits other children																							
1	.96 (.01)	.96 (.01)	.97 (.01)	.99 (.01)	.99 (.01)	.98 (.01)	.98 (.01)	.46 (.07)	.43 (.07)	.39 (.07)	.43 (.07)	.48 (.07)	.34 (.07)	.44 (.08)	.00 (.17)	.00[a]	.00[a]	.00[a]	.00[a]	.00[a]	.00[a]		
2	.04 (.01)	.04 (.01)	.03 (.01)	.01 (.01)	.01 (.01)	.02 (.01)	.02 (.01)	.54 (.07)	.57 (.07)	.61 (.07)	.52 (.07)	.52 (.07)	.64 (.07)	.56 (.08)	.93 (.19)	.81 (.13)	.95 (.07)	.95 (.09)	.71 (.23)	.13 (.10)	.55 (.29)		
3	.00[a]	.00[a]	.00[a]	.00[a]	.00[a]	.00[a]	.0006 (.001)	.00[a]	.001 (.003)	.00[a]	.05 (.02)	.00[a]	.02 (.02)	.00[a]	.07 (.07)	.19 (.13)	.05 (.07)	.05 (.09)	.29 (.23)	.87 (.10)	.45 (.29)		
Rating category																							
Conditional probability estimate for Physically attacks people																							
1	.98 (.01)	.99 (.01)	.99 (.01)	.98 (.01)	.98 (.01)	.98 (.01)	.98 (.01)	.50 (.09)	.55 (.06)	.44 (.07)	.28 (.07)	.31 (.08)	.22 (.07)	.24 (.09)	.00[a]	.11 (.13)	.33 (.15)	.00[a]	.00[a]	.00[a]	.00[a]		
2	.02 (.01)	.01 (.01)	.01 (.01)	.01 (.01)	.02 (.01)	.02 (.01)	.02 (.01)	.50 (.09)	.45 (.06)	.53 (.07)	.72 (.07)	.69 (.08)	.78 (.07)	.76 (.09)	.96 (.05)	.77 (.15)	.57 (.16)	.09 (.20)	.64 (.24)	.14 (.19)	.43 (.30)		
3	.00[a]	.00[a]	.00[a]	.01 (.004)	.00[a]	.0003 (.001)	.00[a]	.00[a]	.00[a]	.04 (.02)	.00[a]	.00[a]	.00[a]	.00[a]	.04 (.05)	.12 (.10)	.10 (.09)	.91 (.20)	.36 (.24)	.86 (.19)	.57 (.30)		
Rating category																							
Conditional probability estimate for Gets into many fights																							
1	.84 (.02)	.87 (.02)	.80 (.02)	.77 (.02)	.82 (.02)	.76 (.02)	.75 (.02)	.17 (.10)	.06 (.05)	.33 (.06)	.21 (.06)	.14 (.08)	.11 (.05)	.17 (.06)	.25 (.25)	.09 (.12)	.00 (.09)	.23 (.16)	.76 (.21)	.00[a]	.00[a]		
2	.14 (.02)	.12 (.02)	.19 (.02)	.21 (.01)	.16 (.02)	.23 (.02)	.22 (.02)	.77 (.10)	.85 (.06)	.67 (.06)	.66 (.06)	.76 (.08)	.67 (.06)	.65 (.07)	.53 (.27)	.00 (.06)	.00 (.12)	.38 (.18)	.00 (.01)	.00[a]	.00[a]		
3	.02 (.01)	.01 (.01)	.01 (.003)	.02 (.01)	.02 (.006)	.01 (.004)	.03 (.01)	.07 (.04)	.08 (.04)	.003 (.02)	.13 (.04)	.11 (.04)	.22 (.05)	.19 (.06)	.23 (.18)	.91 (.13)	1.0 (.15)	.39 (.17)	.24 (.21)	1.0 (.00)	1.0 (.00)		

Note: Standard errors are presented in parentheses.
The preferred model for boys is the null association model, which stipulates that there is no association between age and physical aggression beyond that expected by chance alone. In contrast, the preferred model for girls is the uniform association model, which stipulates an age trend in the prevalence of physical aggression.
[a]Boundary estimate (i.e., 1 or 0).

away from physically aggressive behaviors to avoid self-criticism and maintain self-worth [Bussey and Bandura, 1999; Maccoby, 2002; see also Kochanska et al., 2000].

On the other hand, our results suggest that there are no age differences in the prevalence of physical aggression for boys. Hence, even though the likelihood of exhibiting some physically aggressive behaviors may be smaller among older children [Tremblay et al., 1996], the proportion of physically aggressive boys in the generally population does not seem to vary across age groups. The development of aggressive behavior in boys during the elementary school years may be characterized by some form of equilibrium, with as many boys drifting into as there are drifting out of exhibiting physically aggressive behaviors on a frequent basis over time.

Together, these results suggest that the magnitude of gender differences in the prevalence of physical aggression may be increasing during the elementary school years. Note that one has to be very cautious when interpreting our results this way, however (see limitations below). This interpretation is consistent with the results of another recent NLSCY study that suggests that 8–9-year-old physically aggressive girls are more likely than their male counterparts to have stopped exhibiting physically aggressive behaviors on a frequent basis 2 years later; and conversely, that 8–9-year-old non-physically aggressive boys are more likely than their female counterparts to have started exhibiting physically aggressive behaviors on a frequent basis 2 years later [Baillargeon et al., 2004].

From a methodological point of view, the latent class model adopted in this study provided a maximum likelihood—asymptotically unbiased and efficient—estimate of the prevalence of physical aggression in the general population. Whenever a cutoff point is used to distinguish between aggressive and non-aggressive children, even low rates of false-positive error can result in gross overestimates of the prevalence of physical aggression. Moreover, classification errors can yield a biased estimate of age differences in the prevalence of physical aggression [Goldberg, 1975]. For example, if there are more children who are incorrectly classified as being physically aggressive in the younger age groups than in the older age groups, one may be led to reject the null hypothesis of no age differences, when in fact it is true. In this study, the odds of being physically aggressive were compared across age groups using odds ratios that were directly estimated from the observed data.

There are, however, limitations to this study. First, the prevalence estimates were derived using a single source informant, namely, the PMK about the child—in most cases the mother. Results could be partly due to the particular response style of the PMK. However, parents' reports of their children's aggressive and disruptive behavior have been shown to be reliable and valid [Kingston and Prior, 1995; Soussignan et al., 1992]. In addition, as it is often the case with behavior checklists, the PMKs were not provided with an operational definition of "sometimes or somewhat true" and "often or very true". This may have contributed extra variability to our conditional probability estimates. However, this is unlikely to have comprised in any meaningful way our ability to distinguish between occasional and frequent aggressive behavior. Of course, this is assuming that it is legitimate to equate as we did in this study a rating of "sometimes or somewhat true" to exhibiting the behavior occasionally; and similarly, a rating of "often or very true" to exhibiting the behavior frequently. In The Merriam-Webster Dictionary [Merriam-Webster, 2004], "occasionally" is given as a synonymous cross-reference for "sometimes" and "frequently" is given as a synonymous cross-reference for "often". Another limitation of this study is that we did not provide a statistical test of whether age differences in the prevalence of physical aggression varied between boys and girls. This would have been extremely difficult to do under the unrestricted three-class model, however. In fact, under this model the association between the behavior items and the latent physical aggression variable is free to vary between boys and girls within any given age group. (This corresponds to a four-way interaction of the behavior item with the latent variable, gender, and age.) In other words, the ordering of the latent classes within the latent physical aggression variable was free to vary between boys and girls (e.g., low–medium–high for boys and high–medium–low for girls) making it practically impossible to test for an age by gender interaction effect in the prevalence of physical aggression. Finally, there is a need to use data from subsequent collection cycles of the NLSCY to test for the presence of possible generation (secular) effects in the prevalence of physical aggression.

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