Prediction of Differential Adult Health Burden by Conduct Problem Subtypes in Males

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Context: A cardinal feature of the DSM-IV diagnostic criteria for conduct disorder is the distinction between childhood- vs adolescent-onset subtypes. Whether such developmental subtypes exist in the population and have different prognoses should be rigorously tested to inform the DSM-V.

Objectives: To evaluate the epidemiological validity of childhood- vs adolescent-onset conduct problems in a prospective birth cohort, and to assess whether life-course-persistent conduct problems are associated with a greater adult health burden.

Design, Setting, and Participants: Our sample includes 526 male study members in the Dunedin Multidisciplinary Health and Development Study, a 1-year birth cohort (April 1, 1972, through March 30, 1973). Developmental trajectories were defined using prospective ratings of conduct problems at 7, 9, 11, 13, 15, 18, 21, and 26 years of age.

Main Outcome Measures: Health burden was assessed as mental and physical health problems at 32 years of age measured via diagnostic interviews and physical examinations.

Results: We identified the following 4 developmental subtypes of conduct problems through general growth mixture modeling: (1) childhood-onset/life-course-persistent, (2) adolescent onset, (3) childhood limited, and (4) low. At 32 years of age, study members with the life-course-persistent subtype experienced the worst health burden. To a lesser extent, those with the adolescent-onset subtype also experienced health problems. A childhood-limited subtype not specified by DSM-IV was revealed; its adult health outcomes were within the range of the cohort norm.

Conclusions: Results support the epidemiological validity of the DSM-IV conduct disorder distinction based on age of onset but highlight the need to also consider long-term persistence to refine diagnosis. Preventing and treating conduct problems has the potential to reduce the adult health burden.

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INCE LEE ROBINS’ SEMINAL 1966 PUBLICATION, _Deviant Children Grown Up_, it has been known that conduct disorder (CD) in childhood predicts negative life outcomes. Longitudinal research has consistently identified childhood-onset conduct problems as one of the most robust predictors of later involvement in serious offending behavior. The unique risks that accompany early-onset conduct problems have been recognized in the distinction between childhood- and adolescent-onset subtypes of CD made by the DSM-IV. During the past decade, research generated by a developmental taxonomy of antisocial behavior has refined this distinction by identifying a relatively small but persistent and pathological subgroup of male individuals who demonstrate conduct problems that begin in childhood and persist into adulthood; this subgroup, classified as life course persistent (LCP), has been shown to have unique neurodevelopmental origins that are exacerbated by high-risk social and familial contexts. Like the DSM-IV, the taxonomy contrasts the LCP subtype against a more common and transient subtype, classified as adolescent limited, whose antisocial behaviors emerge during adolescence but are expected to desist once they reach adulthood.

The fundamental divide between childhood- vs adolescent-onset CD has guided research and policy debates and become a dominant heuristic within clinical practice. The validity of this distinction, however, has not been fully tested and should be delineated before the DSM-V is written. At least 2 important questions remain unanswered: first, whether childhood- and adolescent-onset subtypes can be identified within the population (epidemiological validity) and, second, whether these subtypes have different adult prognoses (predictive validity). The present study benefits from state-of-the-art techniques for the analysis of longitudinal data to test whether these subgroups can be recovered from a 30-year epidemiological cohort. This research also expands previous work by testing whether predictive validity can be extended to encompass health outcomes in adulthood. Specifically, we ask whether individuals in...
the LCP class have the highest rates of mental and physical health problems by 32 years of age. To our knowledge, this is the first study to test the epidemiological and predictive validity of the childhood- vs adolescent-onset distinction within a population cohort.

TESTING EPIDEMIOLOGICAL VALIDITY

The application of general growth mixture modeling (GGMM)\(^{12-14}\) allowed us to assess whether the childhood- and adolescent-onset subgroups could be identified within our population cohort. The GGMM procedure identifies the ideal number of classes that underlie a population distribution and provides parameters that characterize each class. Four criteria are used to query whether the hypothesized classes are present. First, does the model that demonstrates the best empirical fit also contain the expected number of classes? Based on the DSM-IV, the following 3 classes are expected: childhood onset, adolescence onset, and normative (low). Second, does the shape of each class map on to the developmental taxonomy? The childhood-onset (LCP) class is expected to have high levels of conduct problems beginning in childhood and persisting to adulthood. The adolescent-onset (or adolescent-limited) class is predicted to initiate conduct problems in midadolescence and desist in adulthood, whereas the low class is expected to remain low across development. Third, are the estimated prevalence rates of each class comparable to the rates implied by the taxonomy? The LCP class is expected to be relatively small (5%-10%), the adolescent-onset class should be more common, and the low class should constitute most of the population.\(^7\) Fourth, the solution is externally validated by asking whether the profile of childhood risk in the LCP class is differentially characterized by social, familial, and neurodevelopmental deficits, whereas the profile of the adolescent-onset class is not.

TESTING PREDICTIVE VALIDITY

The utility of the distinction between childhood- and adolescent-onset forms of conduct problems can also be evaluated in terms of predictive validity. Research to date has consistently linked the LCP pathway to continued involvement in antisocial and criminal acts.\(^7,15\) However, adult prognosis has been hypothesized to extend beyond crime to encompass mental and physical health problems.\(^16\) If this prediction holds, the cumulative burden of disease for individuals in the LCP class may be greater than assumed. The design of this study allowed us to link conduct problem subtypes among study members with their adult health burden, herein assessed according to the presence of mental health problems, physical health problems, and victimization of others.

METHODS

PARTICIPANTS

Participants are male members of the Dunedin Multidisciplinary Health and Development Study, and study protocols were approved by the institutional review boards of the participating universities. The cohort of 1037 children (51.6% male) was constituted at 3 years of age, when investigators enrolled 91.0% of consecutive births from April 1, 1972, through March 30, 1973, in Dunedin, New Zealand. Cohort families represent the full range of socioeconomic status in New Zealand’s South Island and are primarily white. Follow-up assessments were conducted with informed consent at 5, 7, 9, 11, 13, 15, 18, 21, 26, and 32 years of age, when 95.8% of the living study members underwent assessment in 2003 to 2005. Cross-national comparisons lend confidence regarding the generalization of findings from the Dunedin Study population to other industrialized nations.\(^17\)

MEASURES

Conduct problems were measured at 7, 9, 11, 13, 15, 18, 21, and 26 years of age through scoring the following 6 key symptoms of CD as being present or absent at each age: physical fighting, bullying others, destroying property, telling lies, truancy, and stealing. A composite score, ranging from 0 to 6, was formed representing antisocial behavior during the past year. Other CD symptoms were not used because they did not cover the study’s age span (eg, running away and staying out late) or had very rare prevalence (eg, fire setting, forced sex, and animal cruelty). Each of the 6 conduct problem symptoms was operationalized through multiple items collected at each age. Item content was adapted across the age span to ensure that the measures were developmentally appropriate. For example, truancy included items such as skipping school for younger students and work absenteeism for older, employed study members; bullying included items such as bullying other children, threatening violence, and, at older ages, robbery; and stealing included items such as stealing from school or home, shoplifting, auto theft, absconding from a rental with unpaid bills or rent, and embezzlement from employers. The study’s reporting sources were also developmentally appropriate, including parents and teachers in childhood; self, parents, and teachers in adolescence; and self alone in adulthood. Further details are presented elsewhere.\(^17\) The developmental appropriateness of the scale was supported by multiple-group confirmatory factor analysis in which equality constraints on the factor loadings across the ages of 7 to 26 years did not significantly reduce the model fit ($\Delta\chi^2 = 25.1/\Delta df = 20$, $P = .20$).

CHILDHOOD PREDICTORS

Parent criminal conviction was measured by parental report in 1998, when the parents’ ages ranged from 40 to 75 years. Of parents, 13.2% reported they had been convicted of a crime.\(^17\)

Socioeconomic status was measured as the highest of the father’s or the mother’s occupation using a 6-point scale for New Zealand\(^18\); 20.9% of the families were classified as having low socioeconomic status.

Maltreatment was measured using staff observations of rejecting mother-child interaction at 3 years of age, parental reports of harsh discipline at 7 and 9 years of age, 2 or more changes in primary caregivers to 11 years of age, and retrospective reports by study members at 26 years of age of injurious physical abuse or unwanted sexual contact before 11 years of age. In all, 9.2% of the sample had 2 or more indicators of maltreatment.\(^19\)

The mother’s IQ was tested using the Science Research Associates Verbal Form\(^20\) when the children were 3 years of age (score standardized to population mean, 100; SD, 15). A low IQ in the mother was defined as less than 85 on the standardized score.

The child’s IQ was tested using the Wechsler Intelligence Scale for Children–Revised\(^11\) at 7, 9, 11, and 13 years of age, and the 4 values were averaged to enhance reliability (score stan-
dardized to population mean, 100; SD, 15). A low IQ in the child was defined as less than 85 on the standardized score.

Undercontrolled temperament was measured through staff ratings after observing the child in a 90-minute testing session with an unfamiliar examiner at 3 years of age. Factor and cluster analyses reduced these ratings to 3 temperament types, including the undercontrolled type, since replicated in other samples.

Attention-deficit/hyperactivity disorder was measured using the Diagnostic Interview for Children–Child Version at 11, 13, and 15 years of age. Diagnoses were made according to the DSM-III and confirmed through parent or teacher report. Of the male children met diagnostic criteria for attention-deficit/hyperactivity disorder.

MENTAL HEALTH OUTCOMES AT 32 YEARS OF AGE

Psychiatric disorders during the past year at 32 years of age were assessed in private structured interviews using the Diagnostic Interview Schedule for DSM-IV. Diagnoses were made according to the DSM-IV criteria. Prevalence rates in the Dunedin cohort are similar to those from American epidemiological surveys.

For this report, we examined grouped anxiety disorders (generalized anxiety disorder, obsessive-compulsive disorder, panic disorder, agoraphobia, social phobia, and simple phobia), major depressive disorder, cannabis dependence, dependence on other drugs, alcohol dependence, and posttraumatic stress disorder.

Indicators of mental health impairment in the 6 years from 26 to 32 years of age were measured using a life history calendar. Study members reported periods when they received outpatient treatment for mental health or substance abuse problems, periods when they took psychiatric medication, all psychiatric inpatient hospitalizations and suicide attempts, and periods when they were homeless or were taken in by friends or relatives because they had no place to live.

Partner abuse in the past year at 32 years of age was measured in a standardized interview about 13 physical abuse acts (eg, slapping, strangling, kicking, hitting, beating up, forcing sex, and using a weapon) and 13 controlling abuse acts (eg, damaging their partner's clothes, car, or pet; stopping their partner from contacting family or friends; and stalking). Results are presented for the 87.1% of men who were in a relationship or who had dated in the past year. The men's self-reports have been previously validated against their partners' reports.

Self-reported violence in the past year at 32 years of age was measured using the US National Youth Survey Self-report Crime Interview. Items ascertained simple assault, aggravated assault, gang fighting, robbery, arson, and forced sex. Assaults against partners were excluded to avoid overlap with the partner abuse measure.

Conviction for violent crimes (official) from 26 to 32 years of age was measured using the computerized New Zealand police database. Convictions included but were not limited to common assault, common domestic assault, assault of a child, assault with a weapon, rape, indecent assault on a female, robbery aggravated with a firearm, assault of a female subject by a male subject with a weapon, resisting police, and arson.

PHYSICAL HEALTH OUTCOMES AT 32 YEARS OF AGE

Self-reports of Health

Study members provided reports of their overall health on a 5-point scale (1 indicates poor; 5, excellent). They also reported how often they received treatment for physical health problems from a general practitioner and whether they had been hospitalized in the past year.

Cardiovascular Disease Risk

Because the cohort is still too young to present clinical end points of cardiovascular disease (eg, myocardial infarction), we focused on multiple risk-factor clustering as a measure of cardiovascular risk. Six biomarkers were used: overweight, high blood pressure, elevated total cholesterol level, low high-density cholesterol level, elevated glycosylated hemoglobin level, and low maximum oxygen consumption. Study members were clustered if they had at least 3 risk factors.

High-Sensitivity C-Reactive Protein

High-sensitivity C-reactive protein level is thought to be one of the most reliable measured indicators of vascular inflammation and has been recently endorsed as an adjunct to traditional risk factor screening for cardiovascular risk. Individuals with high-sensitivity C-reactive protein levels higher than 3.0 mg/L were considered to be at high risk.

Respiratory Function

Respiratory function was assessed with the use of a computerized spirometer and body plethysmograph; technical details are provided elsewhere. Measurements of vital capacity were repeated to obtain at least 3 repeatable values (within 5%), followed by full forced expiratory maneuvers to record forced expiratory volume in 1 second. The ratio of the forced expiratory volume in 1 second to vital capacity is reported as the primary lung function measure because it is the most sensitive measure for assessing airway remodeling in a large cohort. Study members self-reported symptoms of chronic bronchitis as chronic coughing and phlegm. Smoking during the past year was assessed as part of the Diagnostic Interview Schedule. Tobacco dependence was diagnosed according to DSM-IV criteria.

SEXUAL HEALTH

Serology for herpesvirus 2 infection was performed using an indirect enzyme-linked immunosorbent assay (HerpeSelect 2 ELISA IgG; Focus Technologies, Cypress, Calif). Herpesvirus 2 infection was diagnosed using a cutoff value of 3.3, and any equivocal result (from 0.9 to 3.5) was resolved using herpesvirus 2 Western blot analysis.

DENTAL HEALTH

Examinations were conducted using calibrated dental examiners in all 4 quadrants; technical procedures are described elsewhere. We report the number of untreated decayed surfaces present at 32 years of age and the presence of gum disease (defined as ≥2 sites with ≥4 mm of combined attachment loss).

INJURIES

Study members reported serious injuries between 26 and 32 years of age, defined as any injury requiring treatment from a physician, a medical center, or emergency services. We report the percentage who experienced an injury and, among these individuals, the percentage with a non–sports-related injury.

STATISTICAL ANALYSES

Analyses proceeded in 3 steps. First, we used GGMM to identify subclasses of individuals on the basis of distinct profiles of conduct problems from 7 to 26 years of age. The GGMM procedure...
is an extension of latent growth curve modeling\textsuperscript{49,50} in which key parameters of the growth process are allowed to vary by trajectory class. In traditional latent growth curve modelling, \( Y \) is an observed variable assessed over multiple occasions (\( t = 1 \) to \( T \)) on some persons (\( n = 1 \) to \( N \)) and can be represented as \( Y[t] = y[t] + A[t]e[t] + e[t] \), where \( y[t] \) represents an individual’s initial level of conduct problems; \( y \) represents an individual’s change over time; \( A[t] \) represents the basis weights that define the shape of change over time for the group; and \( e[t] \) represents measurement error at each occasion. General growth mixture modeling differs from traditional latent growth curve modeling in that it does not assume that individuals are drawn from a single population and instead allows subclasses of individuals to vary around different mean growth curves.\textsuperscript{13} The GGMM procedure has been widely applied in developmental research. The technical details of GGMM are described elsewhere.\textsuperscript{15}

Models were fitted in Mplus version 3.13\textsuperscript{52} using maximum likelihood estimation. Classification quality was assessed through recommended indices, including the Bayesian information criterion,\textsuperscript{53} Akaike information criterion,\textsuperscript{54} Lo-Mendell-Rubin likelihood ratio test,\textsuperscript{55} and entropy.\textsuperscript{14} Missing data were handled through full information maximum likelihood\textsuperscript{56}: 98.1% of the sample had 3 or more observations and 81.7% had complete data for at least 7 of 8 observations. Individuals were assigned to their most likely class based on posterior probabilities. Second, as one means of validating the solution, we conducted standard between-group tests (eg, \( y^2 \) test and analysis of variance) using childhood covariates previously hypothesized to differentiate the classes. Third, to evaluate the predictive validity of the GGMM solution, we compared classes on health outcomes at 32 years of age.

### RESULTS

A 4-class model was selected as the best model on the basis of empirical fit indices (Bayesian information criterion, 12 905.0; Akaike information criterion, 12 905.0; entropy, 0.80; Lo-Mendell-Rubin likelihood ratio test, \( P < .001 \)) and correspondence with a priori expectations derived from the DSM-IV and the developmental taxonomy. As demonstrated in Table 1, the decrease in the Bayesian information criterion (13 126.8 to 12 930.0) and Akaike information criterion (13 106.0 to 12 905.0) between a 3- and a 4-class model was large, and the Lo-Mendell-Rubin likelihood ratio test favored rejecting the 3-class model (\( P < .001 \)). Moving from a 4- to a 5-class model, however, was not well supported; the relative change in the Bayesian information criterion (12 930.0 to 12 915.8) and Akaike information criterion (12 905.0 to 12 886.4) was small, classification quality was lower (entropy, 0.77), and the Lo-Mendell-Rubin likelihood ratio test favored rejecting the 5-class model (\( P = .43 \)). The trajectories included an LCP class (10.5% of the cohort) who initiated antisocial behavior in childhood with persistence into adulthood, an adolescent-onset class (19.6%) whose conduct problems emerged during adolescence, a childhood-limited class who demonstrated conduct problems in childhood but subsequently desisted (24.3%), and a low class (45.6%) characterized by low levels of conduct problems (Figure).

Table 2 presents the prevalence of childhood risk factors by trajectory-class membership. Results from this table highlight 3 main findings. First, the LCP class had the most compromised childhood histories as indexed by measures of social, familial, and neurodevelopmental deficits. The LCP class differed significantly from the other 3 classes on measures of parental criminality, socioeconomic status, and childhood diagnosis of attention-deficit/hyperactivity disorder (columns A, B, and C). The LCP class also differed significantly from the low and adolescent-onset classes on childhood measures of maltreatment and IQ (columns A and C). Second, the adolescent-onset class bore the closest resemblance to the low class on childhood risk factors, with no statistically significant differences between the adolescent-onset and low classes on measures

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Table 1. Fit Indices for GGMM Solutions Among 526 Males in the Dunedin Multidisciplinary Health and Development Study

<table>
<thead>
<tr>
<th>No. of Latent Classes</th>
<th>BIC*</th>
<th>AIC*</th>
<th>Entropy†</th>
<th>LMR-LRT‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13 990.39</td>
<td>13 978.20</td>
<td>···</td>
<td>···</td>
</tr>
<tr>
<td>2</td>
<td>13 308.39</td>
<td>13 292.00</td>
<td>0.81</td>
<td>.008</td>
</tr>
<tr>
<td>3</td>
<td>13 126.77</td>
<td>13 106.00</td>
<td>0.81</td>
<td>.01</td>
</tr>
<tr>
<td>4</td>
<td>12 930.00</td>
<td>12 905.00</td>
<td>0.80</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>5</td>
<td>12 915.80</td>
<td>12 886.41</td>
<td>0.77</td>
<td>.43</td>
</tr>
<tr>
<td>6</td>
<td>12 877.00</td>
<td>12 843.20</td>
<td>0.76</td>
<td>.89</td>
</tr>
</tbody>
</table>

Abbreviations: AIC, Akaike information criterion; BIC, Bayesian information criterion; GGMM, general growth mixture modeling; LMR-LRT, Lo-Mendell-Rubin likelihood ratio test; ellipses, cannot be calculated.

*Balances model complexity and goodness of fit to the sample data, with smaller values representing a better fit.
†Entropy refers to the average classification accuracy when assigning participants to trajectory classes, with values closer to 1 indicating greater precision.
‡Provides a direct test between 2 models. A low \( P \) value indicates that a \( k - 1 \) class model should be rejected in favor of a model with at least \( k \) classes.

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Figure. Conduct problem trajectories from 7 to 26 years of age in a 4-class model of 526 male study members. LCP indicates life course persistent.
of parental criminality, the mother’s IQ, and attention-deficit/hyperactivity disorder (column D). Third, conduct problems during childhood were associated with multiple childhood risk factors regardless of whether the problems persisted over time. That is, the childhood-limited class differed significantly from the low class on virtually every measure (6 of 7) (column E).

**Table 3** presents mental health outcomes at 32 years of age by trajectory-class membership. Results from Table 3 convey 3 main findings. First, the LCP class generally had the worst mental health outcomes. Differences between the LCP and low classes reached statistical significance for 13 of 15 outcomes (column A) and differences between the LCP and childhood-limited classes were found for 11 of the 15 outcomes (column B). The LCP class also had worse mental health problems than did the adolescent-onset class, with differences reaching statistical significance for anxiety, major depressive disorder, other drug dependency, homelessness, and violence convictions (column C).

The second main finding conveyed in Table 3 is that the adolescent-onset class also experienced mental health problems at 32 years of age. Compared with the low class, the adolescent-onset class was significantly elevated on 9 of 15 mental health outcomes (column D). In particular, the adolescent-onset class was significantly elevated on 9 of 15 mental health outcomes (column D). Third, the childhood-limited class was doing relatively well. Only the following 3 differences between the childhood-limited and low classes reached statistical significance: lung function, smoking, and the number of untreated decayed tooth surfaces, and serious injury.

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To summarize the results in Table 3, we created a summary variable that indexed the number of physical health problems. The mean number of physical health problems and corresponding effect sizes by trajectory class are displayed at the bottom of Table 3. Moderate to large effect sizes were found when the LCP class was compared with all other classes (d = 1.38 vs low; d = 0.79 vs childhood limited; and d = 0.64 vs adolescent onset). Moderate effect sizes were found between the adolescent-onset and low classes (d = 0.64) and between the childhood-limited and low classes (d = 0.42).

**Table 4** presents physical health outcomes at 32 years of age by trajectory-class membership. Similar to the pattern of mental health outcomes, 3 main findings are conveyed by this table. First, to varying degrees, the LCP class had the highest rates of physical health problems. Differences between the LCP and low classes reached statistical significance on 12 of 14 outcomes (column A), and differences between the LCP and childhood-limited classes were found on 8 of 14 outcomes (column B). When compared with the adolescent-onset class, the LCP class had significantly higher rates of general practitioner treatment, cardiovascular risk based on high-sensitivity C-reactive protein levels, smoking, and dental problems (column C).

The second main finding in Table 4 is that the adolescent-onset class also experienced adult physical health problems. The adolescent-onset class differed significantly from the low class on 7 of 14 physical health outcomes (column D), including hospitalization, lung function, symptoms of chronic bronchitis, smoking (use and dependency), decayed tooth surfaces, and serious injury.

To summarize the results in Table 4, we created a summary variable that indexed the number of physical health problems. The mean number of physical health problems and corresponding effect sizes by trajectory class are displayed at the bottom of Table 4. Moderate to large effect sizes were found when the LCP class was compared with all other classes (d = 1.38 vs low; d = 0.79 vs childhood limited; and d = 0.64 vs adolescent onset). Moderate effect sizes were found between the adolescent-onset and low classes (d = 0.64) and between the childhood-limited and low classes (d = 0.42).

These findings take us beyond what we know about conduct problems in 4 ways. First, our results provide support for the epidemiological validity of the distinction made in *DSM-IV* regarding childhood- vs adolescent-onset CD. The final GGMM model contained the expected classes...
What these findings add, however, is the ability to connect a specific developmental pattern of conduct problems to future health problems. For example, the LCP class constituted only 10.5% of the birth cohort males, but they were responsible for 17.5% of the cohort's traffic injuries, 29.4% of the days spent in psychiatric hospitals, 72.2% of the months spent in jail, and 42.3% of the total months where study members were homeless or taken in by friends or relatives.

Our third finding was that individuals who began their involvement in conduct problems in adolescence were at elevated risk for problems in adulthood. This article focused on the adolescent-onset subtype to test the DSM-IV construct. However, the taxonomic theory refers to this group as adolescent limited, a name that implies desistance from criminal offending behavior during young adulthood. The Figure shows that this group did not self-report fewer CD symptoms than did the LCP class at 26 years of age. However, Table 3 shows that, at 32 years of age, the adolescent-onset group scored below the LCP group on age-relevant measures of offending behavior (eg, court convictions for violence). Thus, the data herein provide mixed evidence regarding whether the adolescent-onset group desists from crime, and this remains an empirical question. The taxonomy anticipated that some individuals on the adolescent-limited pathway would offend longer than others if they attracted snares, ie, factors such as addiction that foster of-
founding behavior. The adolescent-onset group had high rates of substance dependence at 32 years of age, and elsewhere we have shown that substance dependence in this cohort promotes persistence of offending behavior.  

Although the prevalence rates of mental and physical health problems are consistently higher among the LCP class, the adolescent-onset class is at risk compared with the low class. In this sense, conduct problems constitute a risk for experiencing adult health problems regardless of age of onset. The adolescent-onset class was also responsible for somewhat more than their share of the overall health burden: they were 19.6% of the cohort, but accounted for 35.0% of the traffic injuries, 36.4% of the days spent in psychiatric hospitals, 25.3% of the months spent in jail, and 28.2% of total months where study members were homeless or taken in by friends or relatives. Although the health of the adolescent-onset class is not as compromised as that of the LCP class, the greater size of the adolescent-onset class accounts for an appreciable fraction of health burden, warranting intensive prevention efforts.

The fourth finding involves the childhood-limited class identified by GGMM. This class included 24.3% of male study members, suggesting that short-term CD symptoms are very common among young boys. Although the childhood-limited class could not be distinguished from the LCP class on CD symptoms at 7 years of age (the confidence intervals overlapped), they were lower on 6 of 7 childhood risk factors (with statistically significant differences on 3 of 7). However, without evidence of persistence, such childhood conduct problems are not sufficient to signal poor outcomes in adulthood.

This study has clear limitations. First, it was challenging to construct a developmentally appropriate measure of conduct problems that could be applied from childhood into adulthood. Although we tested and confirmed measurement invariance across our age range, the trajectory shapes were estimated from composite scores and should be interpreted with room for age-specific measurement error. Second, individuals were assigned to classes on the basis of posterior probabilities of their most likely class membership; however, observed pathways often fall between 2 or more estimated trajectories. Individuals do not follow lockstep with the predicted trajectory for their class. These limitations reaffirm the need to view the trajectories as approximations, not precise maps, of the developmental course of conduct problems.

<table>
<thead>
<tr>
<th>Physical Health (n)</th>
<th>Trajectory Class, % of Subjects</th>
<th>Class Comparison OR (95% CI)*</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Low</td>
<td>CL</td>
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<tr>
<td>Self-report of good/excellent health (494)</td>
<td>57.3</td>
<td>58.3</td>
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<tr>
<td>No. of GP visits, Mean (SD) (493)</td>
<td>1.4 (2.2)</td>
<td>1.8 (2.9)</td>
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<tr>
<td>Hospitalized (495)</td>
<td>6.2</td>
<td>10.0</td>
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<tr>
<td>CVD risk (456)</td>
<td>15.7</td>
<td>22.0</td>
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<td>C-reactive protein level (475)</td>
<td>11.5</td>
<td>14.7</td>
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<tr>
<td>Lung function, FEV1/VC, Mean (SD) (482)</td>
<td>77.7 (6.4)</td>
<td>76.1 (7.1)</td>
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<td>Chronic bronchitis symptoms (494)</td>
<td>18.1</td>
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<td>Smoker (495)</td>
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<td>Herpesvirus 2 (452)</td>
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<td>Decayed tooth surfaces, Mean (SD) No. (476)</td>
<td>1.8 (4.2)</td>
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<td>Gum disease (476)</td>
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<td>Serious injury (491)</td>
<td>55.9</td>
<td>57.3</td>
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<td>Non–sports-related injury (295)</td>
<td>68.3</td>
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<tr>
<th>Summary</th>
<th>Low</th>
<th>CL</th>
<th>AO</th>
<th>LCP</th>
<th>Effect Size‡</th>
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<td>Physical health problems (441)</td>
<td>3.27 (1.52)</td>
<td>3.96 (1.91)</td>
<td>4.30 (1.81)</td>
<td>5.49 (1.95)</td>
<td>1.38 (Large)</td>
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</table>
Third, we did not include female study members. The study of the developmental course of girls’ conduct problems is currently stalled at the question of whether the taxonomy applies to girls,\textsuperscript{17,62-64} Moreover, our initial tests of invariance revealed the complication that symptoms of CD do not index the same construct across ages for girls, suggesting that the sexes could not be fairly compared with each other. A separate set of female-specific analyses is required and will be included in our forthcoming work.

Fourth, this study is based on a single New Zealand cohort. Although the prevalence rates of health and antisocial problems are similar to those in other western nations, and although previous findings about them from this cohort have been replicated,\textsuperscript{17} these findings require replication in other countries. As such, generalization of our findings across sex and cultures is an empirical question left for future research.

Finally, our cohort is young in terms of the age-based and cumulative risk for physical health problems. Therefore, we are likely to have underestimated the eventual health burden for the LCP class. Older cohorts and the continued tracking of our cohort can estimate the full extent of the health burden.

With these limitations in mind, certain implications for clinical practice and prevention can be noted. With respect to clinical nosology, our results provide support for the distinction between childhood- and adolescent-onset CD in the DSM-IV. The LCP class demonstrated a worse childhood-risk profile and more pervasive health problems in adulthood. The adolescent-onset class, however, was also at risk for health problems, suggesting that the current classification system is well positioned to identify children and adolescents who need treatment to prevent poor adult health.

Our results also support the emphasis on persistence in the DSM-IV criteria for CD. Boys on the LCP pathway, characterized by conduct problems that persisted across years, demonstrated poor health outcomes, but their childhood-limited counterparts did not. Based on these findings, it is not clear that the threshold for persistence specified in the DSM-IV is long enough to avoid false-positive diagnoses. Instead, the definition of persistence may need to be lengthened from months to years to capture a more developmentally informative window that can differentiate those who are on an LCP developmental trajectory from those on a childhood-limited one.

Our findings also have implications for prevention. First, the costs of CD may be larger than originally thought. These findings provide one of the first comprehensive assessments of the long-term health burden following conduct problems in childhood and adolescence and suggest that the cost estimates of CD may need to be recalibrated to account for many kinds of health care expenses. Second, the presence of early-onset conduct problems alone may not be sufficient grounds to target a child for intervention; boys with childhood-limited conduct problems showed little risk for future health problems. Rather, interventions may be of highest priority for children with conduct problems plus family risk factors or for children whose conduct problems persist for more than 1 year. Finally, adolescence emerges as a second window of opportunity to reduce adult health burden. Taken together, these findings provide yet another reason to make CD a primary target for prevention.\textsuperscript{55,60}

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