Adolescent Physical Violence
Understanding Societal Trends and Life Outcomes for Perpetrators

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Summary

Adolescent violence is a considerable burden for society worldwide. The economic toll of adolescent violence is high, and violence-related injuries are a major cause of early death and disability among young people. Adolescent violence is related to adverse adult life outcomes for both victims and perpetrators, but detailed knowledge is lacking on mechanisms in the association between the perpetration of violence in adolescence and adult outcomes. The level of adolescent violence in a society also varies considerably over time and in different cultural contexts. Up to now, little research by using individual level data has been conducted to understand why the societal level of violence changes over time. On this backdrop, this thesis aimed to provide new insights on two important questions about adolescent violence. First, repeated cross-sectional surveys were used with the aim to increase our knowledge on time trends the last two decades in the societal level of violent behavior among adolescents, with a special emphasis on how to understand trend changes. Second, a longitudinal study including both self-reports and data from official registers was used to investigate associations between adolescent violence and long-term adult outcomes in the areas of education, employment, and crime, and in particular to scrutinize mechanisms behind observed associations.

This dissertation includes three papers. Paper I used the two cross-sectional UngVold surveys to examine trends in the perpetration of violence among Norwegian adolescents from 2007 to 2015. The surveys were part of a large-scale project on monitoring exposure to violence among Norwegian adolescents. Two nationally representative samples of students in the final year of senior high school (2007: N = 7,033, response rate = 77.3%; 2015: N = 4,530, response rate = 66.2%) participated in a survey answered during two consecutive school hours. The school sample was obtained by Statistics Norway prior to the 2007 survey. In 2007, paper and pencil questionnaires were used, whereas the 2015 study was conducted online. Mediation analyses using the product-of-coefficients method were performed for investigating co-occurring trends in violence and potential explanatory factors in the realms of sociodemographic background, personality characteristics, mental health, substance use, and social relationships. The paper also explored the gendered aspect of adolescent violence, utilizing instruments designed for capturing acts of violence among both boys and girls. Paper II continued the investigation of time trends in adolescent violence, using the two cross-sectional Young in Oslo surveys from 2015 and 2018 to analyze trends in physical fighting among boys and girls in Oslo, the capital of Norway. Co-occurring trends in several important leisure time activities were analyzed using mediation analyses in the counterfactual
framework. The data material was collected as part of the nation-wide Ungdata surveys—a free, web-based survey system for Norwegian municipalities used for monitoring the adolescent health situation on a local level. All junior and senior high schools in Oslo were asked to participate in the surveys. Students at the participating schools were invited to complete an electronic questionnaire in class during a school hour, containing questions about their social lives, health, leisure activities, drug use, and misbehavior. In the 2015 survey, 23,381 students participated, yielding a response rate of 79%. In 2018, 25,287 students participated, with a response rate of 74%. In total, approximately two out of three adolescents in the age group 13–18 residing in Oslo participated in the surveys. Paper III used the Young in Norway Longitudinal study containing survey data, data from official registers, and intelligence test data from the National Conscript Service. The survey data were collected among a nationwide sample of Norwegian students in junior and senior high school (age 13–18) at four time points: 1992 (T1), 1994 (T2), 1999 (T3), and 2005 (T4). Schools were the main sampling unit and all students at selected schools were invited to participate in the survey. The response rate was 97% (n = 12,287) at T1. Only students that still attended the same school as at T1 were included for the longitudinal follow-up. The response rate for the longitudinal sample was 92% (n = 3,844) at T2, 84% at T3 (n = 2,924), and 82% at T4 (n = 2,890). 90% (n = 2,606) of the respondents consented to merging their survey answers with data from official registers. The overall participation rate in the longitudinal study was thus 68% at T3, 67% at T4, and 60% concerning assessment of register data. The final sample in the third paper included in the thesis consisted of boys who at T4 consented to having their survey answers linked to information from official registers and had valid test scores on the intelligence test from the National Conscript Service. In total 1,147 boys consented to linkage of data, of whom 1,083 also had a valid score on the intelligence test. The data material was used to investigate associations between adolescent boys’ physical fighting and adult outcomes in the realms of education, employment, and crime. The study further used confounder and moderation analyses to investigate how observed associations varied according to individual differences in intelligence.

The analyses identified several important individual level factors for understanding societal trends in adolescent violence. Paper I revealed a decline in violence among Norwegian boys and girls from 2007 to 2015 of about 50%, which in mediation analyses particularly was related to a co-occurring decline in problematic alcohol use. Co-occurring declines in aspects related to social relationships, such as experiences with family violence and having had a romantic partner, were also of importance for understanding the decline in
violence. The analyses further revealed a gendered pattern of adolescent violence: Boys more often than girls reported hitting and kicking, whereas girls more often reported scratching, pulling hair, and slapping someone. Boys also reported more violent acts against acquaintances or unknown adolescents than girls, and girls more frequently reported using violence against adolescent acquaintances, romantic partners, or siblings. Paper II revealed an increase in physical fighting of more than 30% among adolescents in Oslo from 2015 to 2018. Mediation analyses showed the rise in fighting to be related to co-occurring changes in several leisure activities, such as increasing time spent unsupervised by adults, rising digital media use, and rising cannabis use. Finally, Paper III found long-term associations between adolescent boys’ physical fighting and negative adult outcomes in the realms of education, employment, and crime. The associations remained significant also after controlling for important confounding factors, such as family background and both the boys own’ and their friends’ conduct problems. Confounder analyses further identified intelligence as a factor associated with differences in the initial level of adolescent physical fighting and with four of the five included adult life outcomes. Individual differences in intelligence also moderated the association between adolescent boys’ physical fighting and educational attainment 21 years later. Boys with higher intelligence did not experience any negative effects of adolescent physical fighting, whereas boys with lower intelligence experienced a distinct and negative impact of fighting on educational attainment.

The findings in this thesis raise awareness of the importance of considering co-occurring trends in individual level factors for understanding shifting trends in adolescent violence. Even though aggregate changes in larger societal structures might be vital for understanding long-term trends in violence, changes in behavioral factors closer to the individual might be just as important to consider. The thesis also highlights the importance of collecting and utilizing repeated cross-sectional surveys for increasing our understanding of co-occurrence in trends at an individual level. Finally, the thesis identifies negative adult life outcomes of one of the most common acts of violence among adolescents: physical fighting. Research often focuses on more severe acts of violence, but the findings in this thesis show the importance of also considering associations between less severe forms of violence and adult outcomes.
List of Papers

**Paper I**

**Paper II**

**Paper III**
1. Introduction

Violence is a considerable burden for society worldwide and adolescence is the period of life with the highest risk of experiencing violence. Violence is ranked fifth among causes leading to a loss of healthy life years in the age group 10 to 24 years (Gore et al., 2011). Even though a substantial amount of work aimed at reducing the global level of violence has been undertaken the last decades, there has been little change in the overall number of healthy life years lost due to violence among adolescents around the globe (Patton et al., 2016). The financial costs of adolescent violence are also substantial. The global yearly costs of violent crime are estimated at $300 billion (Institute for Economics & Peace, 2014), and youth homicides and assault-related injuries cost the U.S. society alone $18.6 billion per year (Centers for Disease Control and Prevention, 2018). Overall, adolescent violence is having a severe impact on societies all around the world.

In addition to its impact on society, adolescent violence may have harsh consequences for the individuals involved. Immediate injury is one possible outcome, but violence may also cause detrimental effects far into adult life. Among identified long-term outcomes of peer victimization during childhood and adolescence are health risk behaviors such as smoking and drinking, problematic social relationships, mental health issues, poor educational and financial outcomes, and crime (McDougall & Vaillancourt, 2015). Up to now, we know more about long-term consequences for victims of adolescent violence than for perpetrators, but research also shows that the perpetrators are not exempt from negative consequences of their adolescent acts. Studies reveal both poor educational (Kim, 2018; Tanner, Davies, & O'Grady, 1999; Wilczak, 2014) and employment (Tanner et al., 1999) outcomes in adult life for adolescent perpetrators of violence.

The societal level of adolescent violence varies considerably over time and in different cultural contexts. Estimates on historical trends in interpersonal violence back to the 1300s show that we live in peaceful times (Eisner, 2003). Violence levels also fluctuate over shorter time spans, and the last century has seen both major increases and declines (Baumer, Vélez, & Rosenfeld, 2018). In the last two decades, there has been a considerable decrease in adolescent violence and crime in most Western countries that has been labeled “the international crime drop” (van Dijk, Tseloni, & Farrell, 2012) and “the great American crime decline” (Tcherni-Buzzeo, 2019). A concern in contemporary research on trends in crime and violence is a tendency to rely mostly on aggregated data from a societal level, which fails to adequately communicate the importance of considering individual level explanatory factors (Baumer et al., 2018).
This thesis aims to provide new insights on two important questions on adolescent violence. First, repeated cross-sectional surveys are used with the aim to increase our knowledge on time trends the latest two decades in the level of violent behavior among adolescents, with a special emphasis on how to understand trend changes. Second, a longitudinal study including both self-reports and data from official registers is used to investigate associations between adolescent violence and long-term adult outcomes in the realms of education, employment, and crime, and in particular to scrutinize mechanisms behind observed associations. Knowledge on why trends in adolescent violence change and information on the mechanisms of the association between the perpetration of violence and adult outcomes can be used for designing violence prevention programs and thereby help to reduce both the societal and the individual costs of adolescent violence.

This introduction is structured as follows: The remainder of this first chapter presents the theoretical perspectives and empirical context of the research questions in the thesis and a discussion of conceptualizations of violence used in previous research and the gendered aspect of adolescent violence. Chapter 2 describes the overall study aim, as well as the aims of each of the included papers. Chapter 3 contains the methodological aspects of the study and describes the included surveys and instruments, ethical considerations, and analytic strategies. Chapter 4 presents the results of the three papers included in the thesis, and Chapter 5 discusses the results in relation to previous research, elaborates on methodological considerations, and presents implications and suggestions for future research and for youth work practitioners. Chapter 6 offers concluding remarks.

1.1. Defining Physical Violence

Definitions of violence vary substantially between studies, causing, among other things, considerable discrepancies in prevalence estimates, mixed findings on relevant risk and protective factors, and incomparable evaluations of treatment outcomes (Hamby, 2017). Also, the terms aggression and violence are often used interchangeably in research. Aggression is defined as “any behavior intended to harm another person that does not want to be harmed” (DeWall, Anderson, & Bushman, 2011, p. 246). Psychology research often separates aggression from violence, especially highlighting that violence is behavior with the goal is to cause extreme physical harm (DeWall et al., 2011). In public health research, violence is conceptualized more broadly to include all forms of intentional use of force or power likely to cause any form of harm to the victim (Krug, Dahlberg, Mercy, Zwi, & Lozano, 2002). According to Hamby (2017), a proper definition of violence should single out behavior that is
intentional by the perpetrator, unwanted by the victim, unnecessary or nonessential in the given situation, and harmful.

This thesis covers violent acts that frequently occur in peer groups, such as physical fighting, hitting and kicking, and slapping. Considering Hamby’s (2017) conceptualization of violence as behavior that is intentional, unwanted, nonessential, and harmful, the acts included in this thesis might in some aspects be considered violence, in others not. All of the acts are certainly nonessential, and probably also intentional, but adolescent physical fighting might in some situations not be especially unwanted by the participants. Moreover, several of the included acts might not be serious enough to cause extreme physical harm, even though they obviously can cause other forms of harm, such as psychological injuries or maldevelopment. According to conceptualizations of aggression and violence often used in psychological research (DeWall et al., 2011), the acts of peer violence included in this thesis would thus probably be categorized as aggression. This is also reflected in the first paper included in the thesis, which uses the term physical aggression. To acknowledge the possibly harmful effects of peer violence uncovered in previous research (McDougall & Vaillancourt, 2015), the term physical violence is used for all acts included throughout the remainder of this introduction.

1.2. Gender and Physical Violence

Gender is an individual characteristic that is unequivocally related to violence and therefore is a necessity to consider when studying the phenomenon. Physical violence has traditionally been considered a male domain, regarding both the occurrence (Baxendale, Cross, & Johnston, 2012) and the normative aspect (Gilbert, 2002) of the behavior. Studies on gender differences in peer violence usually find at least twice the rate among boys compared with girls (see e.g., Kann et al., 2018; Pickett et al., 2013). Gender differences are especially prominent when measuring serious violence and violent crime (Felson, 2002). However, research has also shown that identified gender discrepancies are less pronounced for some forms of violence. Girls’ aggressive and violent behavior often consist of less serious forms of physical aggression and include victims from close relations (Herrman & Silverstein, 2012), indicating that many instruments used to measure physical violence might conceal certain violent acts more common among girls.

Parts of this thesis covers acts of peer violence expected to be especially gendered, such as physical fighting. The thesis also provides new knowledge on the gendered aspect of peer violence by including instruments designed to measure features of physical violence
hypothesized to be more common among girls, such as hair pulling and slapping. The analyses in Papers I and II cover trends in violence among both girls and boys, whereas Paper III contains information on long-term outcomes of physical fighting among boys only.

1.3. The Prevalence of Adolescent Violence

In a long-term historical sense, violence levels in modern societies are at an all-time low. Estimates show that in the Western world average homicide rates were 30 to 50 times higher in the 13th and 14th centuries compared with rates in the 20th century (Eisner, 2003). Narrowing the time frame, most Western countries showed a substantial increase in violence and crime from the mid-1900s to around 1990, and then levels plummeted in the last two decades (Tonry, 2014). Concerning adolescent violence in particular, reports in the most recent decades show similar developments as for the overall societal level of crime and violence. A cross-national survey among 11- to 15-year-olds in 30 countries in Europe and North America found declining levels of physical fighting in 19 of the participating countries, whereas the level was stable in eight countries, and only three showed an increase (Pickett et al. 2013). Two studies among U.S. adolescents also found marked declines in adolescent violence. Whereas 42.5% of U.S. high school students reported physical fighting the previous year in 1991, the frequency was 23.6% in 2017 (Kann et al., 2018). This is a drop of 44% in 26 years. A second study identified a similar development from 2002 to 2014 (Salas-Wright, Nelson, Vaughn, Reingle Gonzalez, & Cordova, 2017). A study among Swedish adolescents also reported a marked decline in violence from 1995 to 2005 (Svensson & Ring, 2007). Official statistics for violent crime in the United States, Canada, and the United Kingdom concur with self-reported numbers on violent experiences (Farrell, Tilley, & Tseloni, 2014).

For the last few years, however, police records in several countries show a possible trend change, with increasing levels of violence and crime both among adolescents and in the general population. The most prominent increase in adolescent violence were reported in Oslo, the capital of Norway (City of Oslo and Oslo Police District, 2019), but increases in violence and crime were also found in Sweden (Swedish National Council for Crime Prevention, 2020), Denmark (Statistics Denmark, 2020), the United Kingdom (Office for National Statistics, 2020), and the United States (Baumer et al., 2018). The long-term decline in adolescent physical fighting reported in the U.S. Youth Risk Behavior Survey (YRBS) has also ended, with the numbers showing a small (but non-significant) increase from 2015 to 2017 (Kann et al., 2018). In total, evidence indicates that the long-term decline in adolescent violence over the previous decades may have stopped and that societal violence levels in
several Western countries are on the rise. However, it is too soon to tell whether the reported increases are part of a permanent trend change or just represent temporary fluctuations in the societal level of adolescent violence.

1.4. Understanding Time Trends in Adolescent Violence

Even though there is a long history of studying crime trends in the social sciences, far greater attention has been paid to understanding individual variation in crime than to understanding trend changes (Rosenfeld & Weisburd, 2016). Contemporary research on crime trends has also been criticized for focusing too much on single explanatory factors for understanding changes instead of multivariate and theoretically driven causal mechanisms explaining why societal crime levels changes over time (Baumer et al., 2018). To alleviate this lack of theoretical reasoning in the field of crime trends research, Baumer and Wolff (2014) suggested three different causal mechanisms for structuring explanations of why the societal level of crime changes over time: criminal propensity, criminogenic settings, and social control. Criminal propensity refers to factors that may influence the individual’s willingness to either commit crime or refrain from committing crime, criminogenic settings refer to situations surrounding the crime, and social control refers to how both formal and informal social control mechanisms may influence crime levels by strengthening attachments to social institutions or raising perceived costs of committing crime. Table 1 shows how a range of explanatory factors for understanding trends in adolescent violence in the last decades may be understood in relation to the causal mechanisms suggested by Baumer and Wolff (2014).
Table 1

_Hypothesized Causal Mechanisms Initiated by Suggested Explanatory Factors in Trends in Adolescent Violence_

<table>
<thead>
<tr>
<th>Explanatory factor from violence trends literature</th>
<th>Violent propensity</th>
<th>Criminogenic settings</th>
<th>Social control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Securitization of the society</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Law enforcement and policing strategies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Lifestyle and social relationships</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Substance use and policies</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Economic conditions</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Population composition</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Psychotropic medication</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Legalization of abortion</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Lead exposure</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Personality factors and mental health</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

*Note.* Table inspired by Baumer et al. (2018) and Tcherni-Buzzeo (2019).

A hypothesis that has generated attention for understanding the decline in adolescent crime and violence in recent decades is increased securitization of modern societies (Farrell et al., 2014). Technological development has made it harder to commit crime and also decreased the gains, which again influences individual willingness to commit crime. Relating to Baumer and Wolff’s (2014) causal mechanisms, these changes may thus influence the individual propensity for crime by increasing costs and reducing gains, criminogenic settings by technological advances changing traditional arenas of crime, and social control by allowing new forms of control through the same technological advances. The hypothesis has merits for explaining trends in traditional forms of property crime, and it has also been suggested that the decline in property crime has truncated criminal careers to such a degree that it influences the overall societal level of violence (Farrell, Tseloni, Mailley, & Tilley, 2011). Others have still argued that both differing trends in and etiologies of property and violent crime renders the explanation implausible for understanding trends in violence (Tcherni-Buzzeo, 2019).
Several changes in law enforcement and policing strategies have also been hypothesized to impact the societal level of crime and violence, such as a growth in policing, increases in imprisonment, better offender reentry programs, and changes in gun laws (Blumstein & Wallman, 2005). Changes in law enforcement and policing strategies may influence all of the suggested causal mechanisms. The chance of arrest or the severity of the punishment may influence individual propensity for crime. One of the strongest known correlates of crime is previous crime, so better handling of ex-offenders may also be important for altering individual propensity for crime and violence. Police presence may further impact what could be considered criminogenic settings, and law enforcement is also the ultimate form of formal social control. Explanations relating policing strategies and legal regulations are, however, less probable when trends in crime and violence happen simultaneously all over the Western world, as explanations are based on country-specific developments in policy and legal matters (Tcherni-Buzzeo, 2019).

Lifestyle changes among adolescents the most recent decades have also been suggested as important for understanding societal trends in violence. Lack of parental supervision and monitoring of adolescent leisure time activities are known individual level risk factors for problem behavior (Flanagan, Auty, & Farrington, 2019). Leisure time spent unsupervised by adults (Hoeben, Meldrum, Walker, & Young, 2016; Osgood, Wilson, O'Malley, Bachman, & Johnston, 1996) and in unstructured socializing with peers are also known to increase the risk of adolescent violence (Hoeben et al., 2016). Moreover, digital media have undoubtedly had a massive impact on the lifestyle of adolescents in the Western world in recent decades, even though the international crime drop started before the advent of digital media entertainment in young people’s lives (Tcherni-Buzzeo, 2019). The use of digital media is considered important for understanding declining levels of adolescent problem behavior, by limiting the amount of time spent in unstructured physical socializing with peers (Arnett, 2018) and thereby in criminogenic settings. Others have suggested that today’s proliferation of smartphones and access to cheap data traffic among adolescents should result in an increase in the crime rates among young people, as they no longer have to stay at home to use digital media (Green, 2016). Researchers have additionally suggested that aggressive communication and bullying on social media may increase the risk of violent behavior (Cannon, Liggett, & Ueberall, 2015). Changes in adolescent lifestyle may also influence individual propensity for violence through social transfer of norms and values. For example, research has identified an increased risk for violent behavior among individuals who are subjected to violence at home during their upbringing (Braga, Gonçalves, Basto-Pereira, & Maia, 2017). A general decline
in problem behavior among adolescents can also influence how peers react to violence, making peer relationships a possible source of social control. Accordingly, several aspects related to adolescent lifestyle and associated social relationships may be viable explanations of trends in crime and violence in recent decades.

An explanation related to adolescent leisure time is changes in patterns of substance use in recent decades. Substance use, and especially alcohol use, is an often-identified risk factor for violent behavior at the individual level (Tomlinson, Brown, & Hoaken, 2016), so a possible explanation of crime trends may be changing societal levels of substance use. Alcohol intoxication can cause disinhibition and impaired judgment in situations where violent behavior is a possible action, thereby increasing the risk for violence. Especially the use of alcohol has plummeted among adolescents in recent decades (Pape, Rossow, & Brunborg, 2018), even though studies also have suggested that increases in violent crime in some European countries may be related to co-occurring changes in binge drinking (Aebi & Linde, 2010). Cannabis use has also been related to individual propensity for violent behavior in previous research (Liu & Petras, 2017), even though studies have indicated that cannabis and violent behavior are mainly related due to an antisocial lifestyle in general and thereby more time spent in environments susceptible to both cannabis use and violence (Barthelemy, Richardson, Cabral, & Frank, 2016). Research has accordingly also suggested that societal changes in drug policies are important for understanding trends in crime and violence. Violence is more common in milieus that lack mechanisms for nonviolent dispute resolutions. In relation to drug policies, both a lack of regulation and strict enforcement of drugs encourages disputes to be settled without legal assistance and often in a violent manner, thereby increasing the societal level of violence (Dills, Miron, & Summers, 2010). Others have suggested that drug prices influence the societal level of violence, as cheaper drugs will lessen the need for drug users to commit other forms of crime to sustain their usage pattern (Wendel, Dhondt, Curtis, & Hamilton, 2016a, 2016b). As for explanations related to policing strategies and law enforcement, a major drawback with explanations concerning drug policies is a lack of international coherence in policy changes simultaneously as violence levels has declined in most Western countries.

Several aspects related to the composition of the population have also been suggested as important for understanding trends in crime and violence. The association between age and crime has been characterized as “one of the brute facts of criminology,” and late adolescence and early young adulthood are the periods of life with the highest prevalence of crime (Hirschi & Gottfredson, 1983). An aging population may thereby influence the overall level
of crime in a society, simply by reducing the share of the population with a high propensity for crime. Analyses so far have indicated that the demographic composition of societies has little influence on the overall crime rate (Tcherni-Buzzeo, 2019). The degree of immigration in a society is also suggested as important for understanding crime trends, especially in the United States, related to the *American Dream*. Immigration allegedly increases the degree of conformity to social norms in a society and also incorporates a new segment in the population more focused on the opportunity that they have been given for life success than on crime. Studies so far show that immigration may be related to a lower societal level of crime, but the overall impact is very small (Ousey & Kubrin, 2018).

Large-scale changes in structural disadvantage and economic conditions in general may also influence observed levels of adolescent violence (Rosenfeld, 2009). Economic conditions have been suggested as important for understanding crime that results in monetary gain, as it stands out as a viable option for obtaining goods not readily accessible for all. The association between economic conditions and violent crime is suggested to be a result of associations between property crime and violent crime. At an aggregated level, the prevalence of adolescent violence tends to be higher in areas with poor living conditions (Derzon, 2010), indicating that a possible deterioration or improvement of adolescents’ sociodemographic background may influence the overall level of violence in a society. Research has also revealed sociodemographic differences in attitudinal dispositions towards violence as a justifiable means of attaining status and goods at an individual level (Markowitz, 2003). Changes in economic conditions may therefore be related both to the individual propensity of violence and to the overall occurrence of criminogenic settings in a society. However, changes in economic conditions in Western societies have not co-occurred with crime trends (Tcherni-Buzzeo, 2019), weakening the credibility of the hypothesis.

Several explanations particularly emphasizing individual propensity for violence and crime have also been suggested. One is that an increase in the prescription of psychotropic medication among adolescents allegedly has pharmacologically reduced the individual propensity for violence to such a degree that it also influences the overall societal level of violence (Finkelhor & Johnson, 2017). Research indicates that the explanation may have merit, as studies on an individual level have related psychotropic medication to a reduction in aggressive behavior, and the aggregated level of use has expanded in Western countries in the most recent decades. Legalization of abortion (Donohue & Levitt, 2001, 2019) and a reduction of lead exposure (Nevin, 2007; Reyes, 2007) are hypothesized to have similar effects. Abortion is suggested to have reduced the number of unwanted children growing up
in crime-prone surroundings to a degree that it has impacted the overall level of crime and violence in U.S. society. Even though the explanation may seem plausible at first glance, it has also been thoroughly rejected by other researchers based on its selective use of methods and data and its lack of international relevance (Joyce, 2010). A decline in lead exposure during childhood has also been hypothesized as important for understanding crime trends (Nevin, 2007; Reyes, 2007). The suggested mechanism is that lead exposure causes neurobiological damage, influencing the development of self-control. Self-control is one of the strongest known individual-level correlates of crime (Burt, 2020; Gottfredson & Hirschi, 1990), and a decline in self-control may thus result in increased crime during adolescence.

Evidence on the association between lead exposure and crime and delinquency is so far inconsistent. In particular, it has been pointed out that the observed associations are highly dependent on the choice of data (Lauritsen, Rezey, & Heimer, 2016). Changes in other individual characteristics potentially influencing the propensity for adolescent violence may also impact the societal level of violence, such as personality factors and mental health. Personality traits facilitating social competence and mastery have been considered important for understanding why some individuals choose to use violence in situations when others do not. A main argument relates to individual differences in reasoning when presented with situations where violence is a possible action (Harvey, Fletcher, & French, 2001). Mental health issues can also lead to mood instability and a lack of impulse control, which again can increase the risk of violent behavior (Dutton & Karakanta, 2013). No studies have indicated an overall change in personality traits among adolescents across time, rendering the explanation as unlikely, but studies have found a large increase in mental health issues among adolescents in recent decades (Collishaw, 2015).

Summing up, research has provided a range of possible explanatory factors for understanding shifting trends in adolescent violence related to the causal mechanisms suggested by Baumer and Wolff (2014). The tendency to rely on data from an aggregated societal level when assessing trends in adolescent crime and violence has caused the empirical knowledge base to be stronger on factors related to social, demographic, or economic attributes (Baumer et al., 2018). Examples of explanatory factors best studied with data on an aggregated societal level may be the securitization of modern societies (Farrell et al., 2014) and changes in policing strategies and law enforcement (Blumstein & Wallman, 2005). Yet, several of the explanatory factors highlighted as important for understanding declining levels of crime and violence may also be studied based on individual level data, such as the proliferation of digital technology resulting in significant lifestyle changes, a decline in
substance use, and personality factors. Analyses of individual level data may also enable identification of relevant explanatory factors in trends in violence not present in data from an aggregated societal level. This thesis addresses the scarcity of research on the role of individual level factors in time trends in adolescent violence by including putative explanatory factors from a range of different areas: lifestyle changes related to leisure time activities, social relationships, and digital media use; personality characteristics and mental health; substance use; and socioeconomic conditions. The selection of explanatory factors was partly based on observations of potentially relevant trend changes among adolescents later years, such as in substance use (Pape, Rossow, & Brunborg, 2018), in lifestyle due to the use of digital media (Arnett, 2018), and in mental health (Collishaw, 2015), and partly on previous research on individual level risk and protective factors for adolescent violence (Farrington, Gaffney, & Ttofi, 2017; Lösel & Farrington, 2012) as well as on the theoretical mechanisms delineated by Baumer and Wolff (2014). The importance of considering change in individual level factors for understanding trends in adolescent violence is further elaborated on in the first two papers included in this thesis.

1.5. Adolescent Violence and Adult Outcomes

Much is known about the impact of adolescent violence on society worldwide, but less is known about how adolescent violence influences life opportunities for the perpetrators. Studies have shown that adolescent problem behavior is related to adverse adult outcomes in a range of different life areas (see e.g., Bernburg & Krohn, 2003; Lanctôt, Cernkovich, & Giordano, 2007; Makarios, Cullen, & Piquero, 2017). Research highlighting adolescent violence in particular is scarce, but three studies on adolescents in the United States all found associations between adolescent violence and later lack of educational attainment, such as not completing high school, not getting a high school diploma, and years of obtained education in young adulthood (Kim, 2018; Tanner et al., 1999; Wilczak, 2014). Violent delinquency in adolescence has also been associated with occupational status and unemployment in young adulthood (Tanner et al., 1999). The consistency in identified associations between adult outcomes and respectively problem behavior and violence thus indicates that evidence from research on problem behavior in general might be of relevance for research on associations between violence and adult life outcomes in particular.

Even though adolescent problem behavior has been associated with adverse adult life outcomes in several studies, the mechanisms behind the associations are not fully understood. Regarding youth crime in particular, it has been debated whether criminal activity during
adolescence directly influences life chances in adulthood through restricting opportunities for a successful life or whether stable individual characteristics are the underlying cause of both adolescent crime and adverse outcomes in adult life (Nagin & Paternoster, 2000). The potential mechanisms are discussed in more detail below. Studies have also investigated the suggested mechanisms in relation to other forms of adolescent delinquency and problem behavior (see e.g., Makarios et al., 2017), but up to now studies considering violence in particular are lacking.

One suggested mechanism is that adolescent delinquency and crime have a causal effect on perpetrators’ life opportunities. The hypothesis is that problem behavior during adolescence attracts societal reactions that impede chances for success in adult life. This line of thought was popularized through the sociology of Howard Becker (1963) and Erving Goffman (1963), who termed the processes labeling and stigmatization, respectively. The most important formal labels are created by contact with the justice system during adolescence, for example arrests or incarceration. Informal labeling happens when persons and institutions change their perception of and behavior towards an individual due to problem behavior. Future life opportunities are further restricted when individuals are given labels such as deviant or ‘problem child’ and are subsequently treated differently than other people. The most important sources of informal labeling are parents and schools (Bernburg, 2019). Both problem behavior in itself and societal reactions to the behavior become building blocks in stages of cumulative disadvantages regarding future life opportunities. The term “snares” has also been introduced to understand how adolescent problem behavior results in outcomes that could compromise successful transfer to adulthood (Moffitt, Caspi, Harrington, & Milne, 2002). Negative life experiences that originate in problem behavior, such as being incarcerated or becoming a teen parent, ensnares individuals in the life situation surrounding problem behavior, thereby restricting their path towards a successful adult life. The theoretical approach has received widespread support. In a review of the research on labeling theory, Bernburg (2019) demonstrated clear associations between adolescent problem behavior, both formal and informal labeling, and later life outcomes related to education, employment, and subsequent deviancy.

A second suggested mechanism is that stable individual characteristics are responsible for both the occurrence and continuity of crime and its association with adverse outcomes in adult life (Gottfredson & Hirschi, 1990). The hypothesis is that both crime and other forms of problem behavior are caused by individual characteristics that increase the risk for such behavior, and that the same characteristics are also responsible for social maladjustment in
adult life. Differences in the individual characteristics thereby induce a spurious statistical association between adolescent problem behavior and adult outcomes, whereas the true underlying cause is initial differences in antisocial propensity. Of special importance for Gottfredson and Hirschi’s (1990) theoretical argument is the concept of self-control. Self-control theory has received widespread attention and support in empirical research, and self-control is today considered one of the strongest known correlates of crime (Burt, 2020). It is hypothesized that people low in self-control have a tendency to choose the short-term benefits of crime without calculating in the possible negative long-term costs (Gottfredson & Hirschi, 1990). Empirical studies have also identified clear associations between childhood self-regulation—a concept analogous to self-control—and health, substance use, personal finances, and criminal offending in adulthood (Robson, Allen, & Howard, 2020). Accordingly, self-control is related to both the individual’s propensity for crime and delinquency and adverse outcomes in adult life.

Researchers have also advocated the need for including other individual characteristics beyond self-control when evaluating individual antisocial propensity, such as personality factors and neuropsychological deficits (Caspi et al., 1994) and executive functioning and learning abilities (Wilson & Herrnstein, 1985). The third paper of this thesis considers intelligence as a source of individual differences in propensity for perpetration of violence. Previous studies linked low intelligence to the prevalence of both adolescent boys’ physical fighting (Loeber, Green, Lahey, & Kalb, 2000) and violence in the general population (Jacob, Haro, & Koyanagi, 2019), as well as to adverse adult outcomes in the realms of education (Strenze, 2007), employment (Strenze, 2007), and crime (Barker et al., 2007; Schwartz et al., 2015; Ttofi et al., 2016). Based on that, intelligence stands out as a putative explanatory factor in the individual’s propensity to participate in violent behavior during adolescence and also to end up in precarious situations in adult life.

Most scholars today acknowledge the combined impact of both individual traits and social mechanisms attributed to adolescent acts when it comes to explaining why adolescent problem behavior influences later life outcomes (Nagin & Paternoster, 2000). The relative importance of the two suggested mechanisms have been the topic of previous investigations. A recent empirical paper investigated the longitudinal association between adolescent delinquency and adverse adult outcomes concerning education, welfare reception, and sexual risk behavior and concluded with support for models advocating the importance of individual propensity as well as for cumulative disadvantage for understanding associations between adolescent delinquency and adult outcomes (Makarios et al., 2017). The analyses showed that
individual characteristics of the respondents did explain some of the association between adolescent delinquency and adverse adult outcomes. However, adolescent arrests had a significant impact on the included adult outcomes even after controlling for individual differences in personality and vocational aptitude—a test of cognitive ability. Other studies using complex statistical models accounting for individual characteristics have not been able to account for the complete association between adolescent problem behavior and adult outcomes. Even when controlling both for genetic and environmental risk factors through the use of twin models and concurrent psychopathology, Wertz et al. (2018) were not able to account for the complete association between childhood conduct problems and adult life functioning. Piquero, Farrington, Nagin, and Moffitt (2010) also concluded that individual and environmental risk factors could not completely account for identified associations between life trajectories of crime and adult life failure. In total, the evidence shows a robust association between adolescent problem behavior and adverse outcomes in adult life that is not accounted for by individual characteristics, indicating that adolescent problem behavior may have a direct and possibly causal association with outcomes in adult life.

Even though contemporary theorizing acknowledges both differences in individual propensity and direct associations as putative explanations of observed statistical associations between adolescent problem behavior and adult outcomes, we lack knowledge on specific acts of problem behavior during adolescence and other factors in individual propensity than self-control. In this thesis, adolescent violence represents a possible behavior that triggers societal labeling reactions or ensnarement processes and thereby generates disadvantages regarding future life opportunities. Moreover, intelligence represents a feature that potential influences the individual’s propensity for violent behavior. In a study among adolescents in the United States, Tanner et al. (1999) considered the effect of the interplay of violent delinquency and cognitive ability on later life outcomes, even though cognitive ability was only included as part of a wide range of individual characteristics measuring the propensity for delinquency. Individual characteristics explained most of the association between violent delinquency and employment outcomes, and the association between violence and education retained its significance after including the control variables. Tanner et al. (1999) therefore concluded that both adolescent violent delinquency and the individual propensity for delinquency were important for understanding why perpetration of violence was related to both educational and employment outcomes. Based on the results of that study, we can expect that adolescent violence is related to adverse outcomes in adult life and also that individual differences in intelligence may account for parts of the observed associations.
Although it is expected that adolescent violence is related to long-term negative outcomes in several areas of adult life and that individual differences in propensity for violence can account for parts of this association, few studies have investigated whether individual characteristics related to the propensity for violence enhance the negative impact of adolescent violence. If so, the negative long-term impact of violence may be even more profound in certain groups of adolescents, which would highlight them as a particularly important group for violence prevention efforts. Makarios et al. (2017) identified a moderating effect of vocational aptitude on the association between adolescent delinquency and graduating from high school and adolescent pregnancy, respectively, where the association was stronger for those with a low vocational aptitude. Cognitive abilities and adolescent delinquency were individually related to both failure in high school and adolescent pregnancy but combining the two aspects elevated the risk of failure even more. No study has considered possible moderating effects of intelligence on the association between adolescent violence and adult life outcomes. A possible line of reasoning is that adolescent violence instigates societal reactions that result in long-term negative life outcomes, but both the propensity for adolescent violence and negative outcomes in adult life are initially related to individual differences in intelligence. However, the combination of adolescent violence and lower intelligence may be even more profoundly related to negative outcomes in adult life, where adolescents with higher intelligence may possess resources that enable them to mitigate the societal reactions triggered by their acts of violence.

To conclude this section, previous literature reveals a complex interplay between adolescent problem behavior, individual characteristics, and adult life outcomes, especially regarding the mechanisms responsible for generating observed associations. Knowledge is also needed both on particular types of problem behavior and on specific individual characteristics relevant for understanding outcomes in adult life. The third paper of this thesis contains analyses on the association between adolescent physical fighting, intelligence, and adult life outcomes concerning education, employment, and crime, thus providing important knowledge on aspects relevant for increasing our understanding of the adult lives of adolescent perpetrators of violence.

2. Aims of the Thesis

This thesis aims to provide new knowledge on two key questions in research on adolescent violence: why the societal level of violence changes over time, and long-term consequences of violence perpetration during adolescence. First, two papers included in this
thesis investigated trends in the societal level of violence perpetration among Norwegian adolescents, especially focusing on putative explanations of why the societal level of violence changes over time. The third paper investigated life outcomes for adolescent perpetrators of violence, with a special emphasis on mechanisms responsible for the association between violence perpetration during adolescence and outcomes in adulthood.

2.1. Paper I

The aim of the first paper in the thesis was threefold: (1) to investigate trends in the societal level of violence among Norwegian adolescents from 2007 to 2015, using two cross-sectional surveys, (2) to explore whether shifting trends in violence were related to co-occurring changes in a range of hypothesized explanatory factors, and (3) to explore gender differences in the perpetration of physical violence. We expected to find a decline in violence among Norwegian adolescents, and that the decline was related to co-occurring changes in a range of explanatory factors in the following areas: sociodemographic background, personality factors, mental health problems, substance use, and social relationships. Finally, we expected to identify gender differences in the perpetration of physical violence, both with regards to the acts reported by boys and girls, respectively, and the victims of these acts.

2.2. Paper II

The second paper in the thesis continued the investigation of societal trends in adolescent violence by analyzing trends in physical fighting among adolescents in Oslo, Norway, based on two cross-sectional surveys from 2015 and 2018. The paper specifically examined how trends in adolescent fighting were related to co-occurring trends in a range of different leisure time activities. We expected to find an increase in physical fighting among Oslo adolescents from 2015 to 2018 and that the increase would be related to co-occurring increases in leisure time activities happening without adult supervision, the use of digital media, and substance use.

2.3. Paper III

The aim of the third paper in the thesis was twofold: (1) to investigate how adolescent physical fighting is prospectively related adult life outcomes in the realms of education, employment, and crime among Norwegian men, and (2) to explore mechanisms responsible for generating observed associations, especially emphasizing the complex interplay of physical fighting and intelligence in shaping adult life outcomes. We expected that adolescent
physical fighting would be associated with unfavorable outcomes in adult life regarding education, employment, and crime. Further, we expected intelligence to be related both to initial levels of physical fighting and to adult outcomes, and thereby to be a confounding factor accounting for parts of the observed associations. Finally, we expected intelligence to moderate the association between adolescent physical fighting and adult outcomes so that boys with lower intelligence would experience more severe consequences of their adolescent acts than boys with higher intelligence.

3. Materials and Methods

This thesis used five different youth surveys collected by Norwegian Social Research (NOVA): UngVold 2007, UngVold 2015, Young in Oslo 2015, Young in Oslo 2018, and Young in Norway Longitudinal. The respondents’ answers from the latter survey were also merged with data from official registers and intelligence test data from the Norwegian National Conscript Service. This chapter presents detailed information on the procedures and the participants in the different surveys, ethical considerations, the instruments used in the different papers, and methods and analyses.

3.1. Procedures and Participants

3.1.1. UngVold 2007 and 2015 (Paper I)

The first paper included in this thesis used data from the cross-sectional UngVold surveys from 2007 and 2015 (Mossige & Stefansen, 2007, 2016). The surveys were part of a large-scale project on monitoring exposure to violence among Norwegian adolescents, but they also gathered information on other aspects of young people’s lives, such as sociodemographic background, personality factors, mental health, substance use, and social relationships. Students in the final year of senior high school in Norway were invited to participate in the surveys during school hours. The school sample was obtained from Statistics Norway prior to the 2007 survey. To acquire a nationally representative sample, every school in the country was included in a pool from which participating schools were selected. The sample was stratified according to geographical region, and each school’s sampling probability was proportional to the number of students enrolled there, thereby ensuring that the probability of selection was equal for all students in the final year of high school in Norway. In 2015, all the schools that participated in 2007 were invited to participate in the second survey. Five schools had either closed down or been merged with other schools. Of the remaining 62 schools, 41 agreed to participate. Because the sizes of high schools in Norway
had substantially increased from 2007 to 2015, only eight additional schools were invited to participate as replacements to obtain the desired sample size, resulting in a total sample of 49 schools. The replacement schools were selected from the same strata of schools that had either closed down or refused to participate. The surveys were administered over two consecutive school hours, with a teacher present in the room. In 2007, paper and pencil questionnaires were used, whereas the 2015 study was conducted online.

All students at the sample schools were invited to participate in the survey. In 2007, 7,033 students participated (response rate 77.3%). In 2015, 4,530 students participated (response rate 66.2%). The analyses in Paper I of this thesis were restricted to participants 18–20 years of age with valid responses to questions on violent behavior and gender. The final sample consisted of 6,631 participants in 2007 and 4,145 participants in 2015. The samples were compared on a range of different background characteristics to ensure that putative changes in violence levels between the two surveys were not caused by changes in the composition of the two samples. The samples did not differ significantly in the proportion of girls (2007: 58.8%; 2015: 60.3%; \( \chi^2 = 2.18, p = .14 \)), the proportion of students with migration background (2007: 7.9%; 2015: 8.2%; \( \chi^2 = 0.18, p = .69 \)), or the proportion of students with two parents not working (2007: 6.2%; 2015: 6.9%; \( \chi^2 = 1.83, p = .18 \)). The 2015 participants were slightly older than those in 2007 (2007: \( M = 18.30 \); 2015: \( M = 18.37 \); \( t = -6.35, p < .001 \)), and the proportion of students with at least one parent with higher education increased slightly (2007: 63.9%; 2015: 65.9%; \( \chi^2 = 4.28, p = .04 \)). The identified discrepancies were not considered problematic for analyses comparing the two samples.

### 3.1.2. Young in Oslo 2015 and 2018 (Paper II)

The second paper included in this thesis used data from the two cross-sectional surveys *Young in Oslo 2015* and *Young in Oslo 2018* of students in junior and senior high school in Oslo, Norway (Andersen & Bakken, 2015; Bakken, 2018). The data material was collected as part of the nation-wide Ungdata surveys—a free, web-based survey system for Norwegian municipalities used for monitoring the adolescent health situation on a local level. All junior and senior high schools in Oslo were asked to participate in the surveys. All Oslo schools except for schools for students with special needs or difficulties with the Norwegian language and a few private senior high schools accepted the invitation. Students at the participating schools were invited to complete an electronic questionnaire in class during a school hour, containing questions about their social lives, health, leisure activities, drug use, and misbehavior.
In the 2015 survey, 23,381 students participated, yielding a response rate of 79%. The response rates at junior and senior high schools were 86% and 72%, respectively. In 2018, 25,287 students participated, with a response rate of 74%. Response rates were 83% and 65% at junior and senior high schools, respectively. The survey sample included close to all junior and senior high schools in Oslo, so only adolescents that had quit school or were absent from school at the time of the survey were not invited to participate. In total, approximately two out of three adolescents in the age group 13–18 residing in Oslo participated in the surveys. The samples were compared on a range of background characteristics to account for differences between the two survey samples possibly influencing observed associations. The analyses showed that the samples did not differ significantly in the proportion of girls (2015: 51.6%; 2018: 50.8%; $\chi^2 = 2.84, p = .092$) and the proportion of students with a migration background (2015: 33.9%; 2018: 33.8%; $\chi^2 = 0.01, p = .974$). Average years of schooling of the 2015 participants were slightly higher than in 2018 (2015: $M = 10.33$; 2018: $M = 10.25$; $t = 5.16, p < .001$), and socioeconomic background (2015: $M = 1.90$; 2018: $M = 2.06$; $t = -26.08, p < .001$) and average school grades (2015: $M = 4.03$; 2018: $M = 4.11$; $t = -9.25, p < .001$) increased slightly from 2015 to 2018. All background variables were included as control variables in the analyses.

3.1.3. Young in Norway Longitudinal (Paper III)

The final paper included in this thesis used data from the Young in Norway Longitudinal study. The survey started as a cross-sectional survey in 1992, including a nationally representative sample of students in junior and senior high school (age 13–18). Similar to the UngVold surveys used in Paper I of the thesis, schools were the main sampling unit, and schools were stratified according to geographic location. Junior high schools were further stratified according to school size, to make sure that both urban and rural areas were included in the sample. The link between school size and urbanity is less clear in senior high school in Norway, so whether the school provided general education, vocational education, or both was instead used as the stratification criterion in senior high school. The probability of being selected for participation at the school level was proportional to the number of students at the school, to ensure equal probability of participation for all students in Norway. All students at selected schools were invited to participate in the survey.

The survey data were collected at four time points: 1992 (T1), 1994 (T2), 1999 (T3), and 2005 (T4). Participants at T4 were also asked for consent to merge their survey answers with comprehensive information from official registers on educational outcomes, welfare
benefits, crime, and with an intelligence test from the National Conscript Service. The first wave of the survey was implemented at school for all participants. The second wave was implemented at school for those who still attended the same school as at T1, whereas those who had changed schools received a postal questionnaire. Only students who completed the T2 questionnaire at school were followed up at T3 and T4, due to a considerably lower response rate in the T2 postal questionnaires compared to the school-based questionnaires. The study was originally planned to be a two-wave study, so new informed consent had to be obtained at T2 for the T3 follow-up. At T4, the respondents were again asked for their consent to link their survey answers to data from several official registers. Figure 1 depicts a flow chart for study participation. The overall participation rate of the final sample, based on all eligible students at T1 who still attended their original school at T2, was 68% at T3, 67% at T4, and 60% concerning assessment of register data.

The final sample in the third paper included in the thesis consisted of boys who at T4 consented to having their survey answers linked to information from official registers and had valid test scores on the intelligence test from the National Conscript Service. In total 1,147 boys consented to linkage of data, of whom 1,083 also had a valid score on the intelligence test. The initial survey sample differed from the sample used in Paper III in a range of areas possibly confounding observed associations, among them being older ($OR = 1.36; p < .01$), reporting higher levels of conduct problems in both the respondents ($OR = 1.17; p = .03$) and the respondents’ friends ($OR = 1.07; p < .01$), and having a higher prevalence of respondents with migration background ($OR = 3.68; p < .01$). The variables were therefore included as control variables in the analyses.
Figure 1. Flow chart for the Young in Norway Longitudinal study.
3.2. Ethical Considerations

All studies in the papers included in this thesis were conducted in accordance with ethical standards for social science research issued by The National Committee for Research Ethics in the Social Sciences and the Humanities (NESH, 2016). The procedures of the studies used in Papers I and III were also approved by The Norwegian Data Inspectorate and the Regional Committee for Medical Research Ethics, and the ethical aspect of the surveys used in Paper II was approved by the Norwegian Center for Research Data.

The respondents were provided with both written and oral information on the surveys before participating. The information material contained a detailed description of the aim of the surveys and specified that participation was voluntary, that the respondents could at any time choose to skip questions or withdraw their consent to participate, that all material would be handled in a confidential manner by the study group, and that no individuals would be identifiable when results of the studies are presented. Parents of children under the age of 18 were also provided with similar information in writing. The respondents gave their final consent to participate by filling out the survey. In the Young in Norway Longitudinal study used in Paper III, the participants also consented in writing on a separate form. The parents of participants younger than 16 years old at T1 also consented in writing to their children’s participation in the survey. In the Young in Oslo surveys used in Paper II, parents of all participants under the age of 18 were given the option to decline participation for their children, whereas in the UngVold surveys used in Paper I, all participants were over 18 years old. In all surveys the final page of the questionnaires provided the participants with contact information for relevant health personnel at the school, anonymous national help services, and members of the research group, in case they felt the need to talk to someone after responding to the survey.

Even though all data collections used in the thesis were approved by appropriate authorities, collecting data from students in schools still raises some ethical considerations that are worth discussing in detail. A fundamental research principle is that participation should be based on free and informed consent. As described above, the respondents in all the surveys used in this thesis consented to participation when they filled out the surveys. Yet, the context of the consent was the school, which might influence how ‘free’ the students found consent to be. The students were asked by an authority person to participate, their teacher, in a context where participation in activities would normally not be voluntary. To ensure free and informed consent, the respondents in all the surveys were thoroughly informed about the
voluntariness of participation, both in writing and orally, so unless the schools did not properly communicate this to the students, participation should be considered both free and informed even though the context of the consent was the school. A second issue relates to the response situation in the classroom. The students filled out questionnaires asking for information on experiences with being exposed to physical violence from their parents, sexual abuse, and participation in criminal activity, among other things, in a situation with their peers in the same room. The schools were instructed to administer the surveys as they would have administered an examination, to prevent answers to the highly sensitive questions from being visible to other students in the class. It might still be difficult to entirely prevent this in a classroom, especially for the surveys conducted digitally.

3.3. Measures

3.3.1. Physical Violence (Papers I, II, III)

The main behavior examined in all three papers included in this thesis was the perpetration of different acts of physical violence. In Paper I, physical violence was measured by three items from an instrument on the frequency of different conduct problems during the last 12 months: “clawed or pulled the hair on someone,” “slapped someone,” and “hit or kicked someone.” The response options were no, yes, and an open field for number of occasions in 2007 and no, yes, once, and yes, more than once in 2015. The items were dichotomized into no instances of the three acts in the previous 12 months versus at least one instance of the acts. A combined instrument of the three single items also separated those who reported at least one act of physical violence the previous 12 months versus those who reported none. The term physical aggression was used throughout the paper.

Papers II and III in the thesis examined a particular act of adolescent violence: physical fighting. Physical fighting was assessed by items from an instrument measuring the frequency of different conduct problems: “How many times have you done any of the following things over the past year (in the past 12 months)?”. Paper III and the Young in Oslo 2015 survey used in Paper II assessed physical fighting with the items “have been in a fight (without weapons)” and “have been in a fight where you used a weapon (e.g., a knife).” The items were combined into a single instrument showing participation in either kind of physical fighting, retaining the maximum score of the two items. One item assessed physical fighting in the Young in Oslo 2018 survey used in Paper II: “have been in a fight.” The response options for both surveys included in Paper II were never, once, 2–5 times, 6–10 times, and 11 times or more, and the response options for the instrument included in Paper III were 0 times,
1 time, 2–5 times, 6–10 times, 10–50 times, and more than 50 times. The instruments were used as frequency measures retaining all categories in Paper II, but the instrument was restricted to show the categories no fighting, once, and more than once in Paper III. The instruments were also dichotomized into no fights versus at least one fight in several analyses.

3.3.2. Victims of Physical Violence (Paper I)

The questions on physical violence included in Paper I were also followed by an item on the victim of the violent act. Respondents who answered in the affirmative to at least one of the three questions on physical violence were asked who the victim(s) were, with response options “acquainted adolescent,” “unknown adolescent,” “girlfriend/boyfriend,” “sibling,” “parent,” and “other adult.”

3.3.3. Explanatory Factors in Time Trends (Papers I & II)

The main aim of Papers I and II was to identify explanatory factors in trends in the societal level of adolescent physical violence. Due to the correlational nature of the surveys included in the studies, putative explanatory factors were selected based on theoretical reasoning (Baumer & Wolff, 2014) and previous research on risk and protective factors for adolescent violence (Farrington et al., 2017; Lösel & Farrington, 2012). The supposed explanatory factors in violence were sorted into seven different main areas in the papers; the areas are presented in alphabetical order in the following.

Adult Supervision (Paper II)

Five indicators in Paper II measured activities and situations related to the presence or absence of adult supervision. First, parental monitoring (Olweus, 1989) was measured using three items on parents’ knowledge of their children’s social life: “My parents usually know where I am, and who I’m with, in my free time,” “My parents know most of the friends I hang out with in my free time,” and “My parents know my friends’ parents.” The response options were not true at all (1), not very true (2), quite true (3), and very true (4). Mean scores were computed, ranging from 1 to 4 (α = .74). Second, a mean score was generated by averaging six items measuring participation in the previous month in the following organized leisure activities: “sports club,” “youth club,” “religious organization,” “band, choir, orchestra,” “cultural school/music school,” and “other organization, team, association.” The response options were never (0), 1–2 times (1), 3–4 times (2), and 5 times or more (3), returning a variable with a range from 0 to 3. Third, a single item assessed how many times in the
previous week the respondents had “been at home the whole evening,” with response options never (0), once (1), 2–5 times (2), and 6 times or more (3). Fourth, a single item with the same response options assessed how many times in the previous week the respondents had “spent the majority of the evening out with friends.” Finally, a single item assessed school truancy in the last 12 months, with response options never (0), once (1), 2–5 times (2), 6–10 times (3), and 11 times or more (4).

**Digital Media Use (Paper II)**

Two items in Paper II tapped different aspects of digital media use. A single item assessed how much time the respondents normally spent outside of school on “activities in front of a screen (TV, computer, tablet, smartphone),” with response options no time (0), less than 1 hour (1), 1–2 hours (2), 2–3 hours (3), 3–4 hours (4), 4–6 hours (5), and more than 6 hours (6). A second item assessed how much time the respondents spent daily on “social media (e.g., Facebook, Instagram, etc.),” with response options no time (0), under 30 minutes (1), 30 minutes to 1 hour (2), 1–2 hours (3), 2–3 hours (4), and more than 3 hours (5).

**Mental Health (Paper I)**

Mental health problems in Paper I were measured by an eight-item version of the Hopkins Symptom Checklist (HSCL; Derogatis, Lipman, Rickels, Uhlenhuth, & Covi, 1974), which assessed aspects of mental health issues the previous week on a scale ranging from not at all distressed (1) to very much distressed (4). The respondents were asked how often they had been “bothered or troubled” by the following states: “suddenly scared for no reason,” “feeling fearful,” “nervousness or shakiness inside,” “feeling too tired to do things,” “feeling blue,” “feeling hopeless about the future,” “feeling tense or keyed up,” and “worrying too much about things.” Internal consistency was high (α = .89), and previous studies have shown that shorter versions of the HSCL perform almost as well as the full version (Strand, Dalgard, Tambs, & Rognerud, 2003).

**Personality Factors (Paper I)**

Three subscales from the Resilience Scale for Adolescents (READ; Hjemdal, Friborg, Stiles, Martinussen, & Rosenvinge, 2006) were included as proxies of personality traits in Paper I: “Personal Competence” (five items; α = .71), “Social Competence” (four items; α = .77), and “Structured Style” (three items; α = .70). The subscales measure individual dispositional attributes of resilience in difficult life situations. Personal Competence measures
an individual’s level of self-esteem, self-efficacy, and a realistic orientation to life (e.g., “I know how to reach my goals” and “I feel competent”). Social Competence measures attributes related to extraversion, social adeptness, good communication skills, and flexibility in social matters (e.g., “I easily find new friends” and “I always find something fun to talk about”). Structured Style measures preference for planning and structure in daily life (e.g., “I always make a plan before I start something new” and “I am good at organizing my time”). The students were asked to evaluate their feelings about themselves and people around them during the past month, and response options ranged from totally agree (1) to totally disagree (5). The instruments were generated as mean scores of the responses to the items in the different subscales. Previous research in both Norway (von Soest, Mossige, Stefansen, & Hjemdal, 2010) and Ireland (Kelly, Fitzgerald, & Dooley, 2017) found that the instrument has acceptable internal consistency and satisfactory convergent validity, as it is correlated with expected social and life outcomes.

Social Relationships (Paper I)

Six instruments in Paper I tapped different aspects of social relationships. First, social resources were measured by one more subscale from READ, “Social Resources” (five items; \( \alpha = .81 \)), developed for measuring perceived availability of social support from friends and relatives (e.g., “My friends always stick together” and “I have some close friends/family members that really care about me”). The respondents were asked to evaluate their feelings in the past month, with response options from totally agree (1) to totally disagree (5). The instrument was generated as a mean score of the five items included in the subscale. Second, parent–child relationship was measured by two subscales of a short version of the Parental Bonding Instrument (Parker, Tupling, & Brown, 1979). The respondents were asked to evaluate parenting styles when they were growing up. The “Overprotection” subscale (six items, \( \alpha = .74 \)) measured parental control and overprotection vs. encouragement of independence, including items such as “They liked me to make my own decisions” and “They tried to control everything I did.” The “Care” subscale (five items, \( \alpha = .77 \)) measured parental care and involvement vs. indifference and rejection (e.g., “They appeared to understand my problems and worries” and “They did not help me as much as I needed”). The response options ranged from corresponds very well (1) to corresponds very poorly (4), and the subscales were generated as mean scores of the included items. Previous research has identified satisfactory psychometric properties (Klimidis, Minas, & Ata, 1992) and convergent validity (Klimidis, Minas, Ata, & Stuart, 1992) of short forms of the Parental
Bonding Instrument. Third, a single item measured whether an adult family member had ever hit the respondent. Finally, peer relationships were measured by two dichotomous items: whether the respondents had ever had a girlfriend/boyfriend, and whether they had any close friends.

Sociodemographic Background (Paper I)

Two items related to sociodemographic background were included in the analyses in Paper I: having two parents currently not working, and not living with both biological parents.

Substance Use (Papers I & II)

Alcohol intoxication was measured in Papers I and II by a question on the frequency of intoxication in the previous 12 months. The item in Paper I had response options never (0), 1–4 times (1), 5–10 times (2), 1–2 times a month (3), 1–2 times a week (4), and several times a week (5), and the item in Paper II had the following response options: never (0), once (1), 2–5 times (2), 6–10 times (3), and 11 times or more (4). Moreover, alcohol-related problems were measured in Paper I by a five-item instrument assessing the frequency of negative consequences of drinking in the previous 12 months (quarreling, short-term memory loss, inhibition of physical function, property destruction, and vomiting), with response options never (0), once (1), 2–4 times (3), 5–10 times (7.5), and more than 10 times (10) (total range: 0–50). The use of illicit drugs was measured in Paper I by three items indicating use in the previous 12 months of cannabis, use of other illicit drugs, and use of intoxicating prescription drugs. The instrument was dichotomized into use of at least one of the included substances vs. no use. Finally, use of cannabis was measured in Paper II by a single item indicating the frequency of use in the previous 12 months, with response options never (0), once (1), 2–5 times (2), 6–10 times (3), and 11 times or more (4).

3.3.4. Intelligence (Paper III)

Paper III included intelligence test scores from the Norwegian National Conscript Service. At the time of the study, it was mandatory for all male Norwegian citizens to be evaluated for eligibility to serve in the military. Enrollment in military service began with a meeting with a conscript board as well as both physical and psychological evaluations, including an intelligence test. About 90% of all men liable for military service attend the meeting (Sundet, Eriksen, Borren, & Tambs, 2010). The intelligence score is based on three different tests: Arithmetic (30 items), Word Similarities (54 items), and Figures (36 items).
The Arithmetic test aims to measure arithmetic and algebraic ability, as well as logical reasoning, and is comparable to the Arithmetic test in the Wechsler Adult Intelligence Scale (WAIS). The Word Similarities test is a synonym test, analogous to the Vocabulary test in WAIS. Finally, the Figures test aims to measure abstract and non-verbal reasoning and is equivalent to Raven’s Progressive Matrices. The intelligence test used by the Norwegian National Conscript Service is highly correlated with WAIS IQ (Sundet, Tambs, Magnus, & Berg, 1988) and has been used extensively in previous publications (see e.g., Sundet et al., 2010).

Scores on the test are presented in stanine units. Stanines are constructed based on sorting individual scores in ranking order, before dividing them into 9 parts. A stanine score of 1 and 9 consists of 4% of the respondents, 2 and 8 of 7%, 3 and 7 of 12%, 4 and 6 of 17%, and 5 of the middle 20%. A stanine score of 5 represents the mean intelligence test score in the 1974 cohort of Norwegian males, with a standard deviation (SD) of 2. Following recommendations from the literature (Aiken & West, 1991), the variable was mean centered in all analyses.

3.3.5. Adult Life Outcomes (Paper III)

Paper III investigated the association between adolescent physical fighting and adult outcomes in education, employment, and crime. The highest completed education level in 2015 was assessed based on register data. The respondents’ educational attainment was categorized as follows: no education after junior high school (1), 1–2 years of education in senior high school (2), completed senior high school (3), 1–3 years of higher education (4), or 4 or more years of higher education (5). Concerning employment, the respondents’ average income in the years 2012 to 2014 was assessed by means of register data. The variable was categorized into 10 deciles, to account for skewness in the distribution of income. Labor market marginalization was assessed by an indicator showing whether the respondents had received social security or disability benefits or participated in work assessment or work rehabilitation in the period 2012 to 2014. Finally, two outcomes were generated based on data from official crime registers. A dummy variable assessed being charged for at least one criminal offence in the period 1996 to 2014. Another dummy variable contrasted charges for violent crimes with charges only for non-violent crimes or no charges. Charges prior to 1996 were omitted, to exclude criminal activity that had happened before the respondents answered the questions about physical fighting in 1994.
3.3.6. Covariates (Papers II & III)

Covariates were included in the papers to handle possible confounding of obtained estimates. Papers II and III included instruments assessing the respondents’ sociodemographic background, based on information on the family’s economic and cultural resources. In Paper II, the respondents’ sociodemographic background was measured by a complex instrument consisting of three dimensions of family resources. The first dimension of the instrument covered the number of parents having a university degree. Having no parents with a university degree was scored 0, having one was scored 1.5, and having two was scored 3. The second dimension of the instrument covered the number of books in the respondents’ home, which is a commonly used indicator of cultural resources. The item was measured on a six-point scale with response options no books (0), fewer than 20 books (0.6), 20–100 books (1.2), 100–500 books (1.8), 500–1,000 books (2.4), and more than 1,000 books (3). The third dimension of the instrument was the average score on the four-item Family Affluence Scale II (FAS II; Currie et al., 2008). FAS II contained four items assessing different aspects of family affluence, each with different response options and different scoring. The first item assessed the number of cars in the family, with response options none (0), one (2), and two (3). The second item assessed whether the respondents had their own bedroom or not, with response options no (0) and yes (3). The third item assessed the number of vacation trips with the family in the previous year, with response options none (0), one (1), two (2), and more than two (3). The final item assessed the number of computers in the family, with response options none (0), one (1), two (2), and three or more (3). The final instrument measuring sociodemographic background, ranging from 0 to 3, was computed by averaging the score on parental education, books at home, and FAS II. In Paper III, the highest level of education attained by a parent when the respondent was 16 years old was assessed by means of data from official registers, ranging from junior high school or lower education (1) to higher university degree (4). Age was assessed by means of data from official registers in Paper III, and average years of schooling was included as a proxy of age in Paper II (range 8–13). Papers II and III also included migration background as a covariate, defined by having two foreign-born parents. Paper II included average school grades (1–6) in the subjects written Norwegian, written English, and mathematics as a covariate. The frequency of conduct problems in the previous 12 months was assessed in Paper III by a 15-item instrument (α = .76) based on the DSM-III-R criteria for conduct disorder, with response options ranging from never to more than 50 times on a 6-point scale. Items ranged from rather common behavior, such as school truancy, to more serious behaviors, such as stealing and vandalism. Finally,
Paper III included an instrument assessing the respondent’s two best friends’ involvement in four different kinds of problematic conduct in the last 12 months; smoking cigarettes, alcohol use at least weekly, smoking cannabis, and being involved with the police. The variable was generated as a sum score indicating the number of positive answers on the four questions, ranging from 0 to 8 (α = .76).

3.4. Statistical Analyses

The main analyses in this thesis were linear and logistic regression analyses (Cohen, Cohen, West, & Aiken, 2003), mediation and confounder analyses (Hayes, 2018; MacKinnon, Krull, & Lockwood, 2000; VanderWeele, 2015), and moderation analyses (Aiken & West, 1991; Hayes, 2018). Most of the analyses were conducted with the statistical software Mplus Version 7.4 to 8.3 to ensure handling of missing data that is considered to be state-of-the-art (Schafer & Graham, 2002), but initial analyses and regression diagnostics such as frequencies, Cronbach’s alpha, and the Hosmer-Lemeshow test were conducted with IBM Statistics SPSS 25. The next section (3.4.1 below) presents the analytic strategies and handling of missing data in more detail.

3.4.1. Regression Analyses

Regression analyses were used in all three papers included in this thesis. In the first two papers, regression analyses were used for exploring time trends in putative explanations of observed trends in the societal level of adolescent violence. One important criterion for functioning as an explanatory factor in the trends in violent behavior was having a significant and co-occurring trend with violence. Logistic regression analyses were used for investigating trends in dichotomous explanatory factors, and results were presented using odds ratios (OR). Linear regression analyses were used for investigating trends in continuous variables, as well as in ordinal variables with five or more categories, as previous simulation studies have identified minimal bias of treating ordinal variables as continuous variables in regression analyses (Bollen & Barb, 1981). Explanatory factors not showing co-occurring trends with violence in the initial analyses were excluded from subsequent analyses. The final analytic models of Papers I and II were also based on regression analyses. Putative explanatory factors showing trends in parallel with the violence measures were included in regression models containing violent behavior as the dependent variable and survey year and explanatory factors as independent variables. The analyses in Paper II also included relevant confounders as independent variables. The models were calculated for each of the explanatory factors
separately as well as for all factors simultaneously. The results of the final analyses in Paper I were presented as OR from logistic regression analyses, and the results from the final analyses of Paper II were presented as risk differences for different counterfactual outcomes, calculated based on predicted probabilities from probit regression analyses. The latter is presented in more detail in section 3.4.2 on mediation analyses.

Linear regression analyses were used in Paper III to assess the association between adolescent physical fighting and adult outcomes measured by continuous and ordinal variables, and logistic regression analyses assessed the association between fighting and adult outcomes measured by dichotomous variables. The analyses were conducted in three steps, the first including only adolescent physical fighting as an explanatory variable, as well as age and migration background as control variables. Intelligence was added as an explanatory variable in the second step of the analyses, and the final step included three potential confounders on the obtained estimates: parental education, conduct problems, and friends’ conduct problems.

3.4.2. Mediation and Confounder Analyses

Mediation analyses were used for studying potential explanations of time trends in adolescent violence as well as to assess confounding. Mediation analysis is a statistical technique for examining mechanisms behind associations between dependent and independent variables. According to Hayes (2018, p. 6), mediation is the process of not only understanding “whether X affects Y, but also how X exerts its effects on Y.” The underlying assumption is that we can increase our knowledge of associations by investigating how including a third variable in a statistical model affects the identified path between the independent and the dependent variable. An often-used framework for conducting mediation analyses is the product-of-coefficients method (Hayes, 2018). In recent years, mediation analyses have been further developed under the counterfactual framework (VanderWeele, 2015), allowing the implementation of more complex models than what is methodologically possible using traditional methods. Both methods were used in this thesis.

In Papers I and II, mediation analyses were used to investigate how time trends in adolescent violence co-occurred with trends in putative explanatory factors in violent behavior. We assessed how observed change from one survey to the next in violent behavior was affected by co-occurring changes in a range of putative explanatory factors by pooling the data material from the cross-sectional surveys and including dummy variables for survey year in the analyses. The change in the coefficient for survey year from models respectively
with and without explanatory factors indicated whether trends in the included factor were of relevance for understanding observed trends in adolescent violence. Figure 2 depicts the analytic model in the papers.

![Analytic Model Diagram]

*Figure 2. The analytic model in Papers I and II.*

The analytic technique can only be used to state that change covaries, not that changes in one factor caused changes in another factor. One central premise concerning cause and effect is the aspect of time, where the cause must precede the effect for something to be considered a causal relation. The variables in the included surveys are measured at one time point only, meaning that no causal associations can be identified.

**The Product-of-Coefficients Method**

The mediation analyses in Paper I were conducted using the traditional product-of-coefficients method. In the model in Figure 2, the total effect $c$ equals the product of the effects of $a$ and $b$ ($a*b$) plus the partial effect $c'$. Mediation analyses using the product-of-coefficients method investigate whether the change from $c$ to $c'$ when the mediator in the model is included is significant. The identification of a significant indirect effect would mean that trends in violent behavior are related to co-occurring trends in the explanatory factor. Confounder effects of intelligence in the association between adolescent physical fighting and adult life outcomes in Paper III were also assessed with techniques originating from mediation analyses using the product-of-coefficients method. The analytic framework in mediation and confounder analyses is the same, with a third variable affecting the association between a dependent and an independent variable (MacKinnon et al., 2000). The difference is that mediation analysis indicates a process where the path between an independent and a
dependent variable is hypothesized to be affected by a third variable, whereas confounder analysis implies that the included third variable affects both the independent and the dependent variable and is the underlying reason causing the observed statistical association between the two variables.

Confidence intervals for indirect effects calculated by the product-of-coefficients method were based on bootstrapping. Bootstrapping is a statistical technique based on resampling from the original sample of the analysis to account for inaccuracy in statistical estimates based on samples from a population. A random sample of $n$ participants from the original sample is treated as a sample of the population, and the analysis is repeated a given number of times with different random samples to obtain several estimates of the coefficients of interest. When repeated enough times—ideally between 5,000 and 10,000 times—the obtained estimates will be close to normally distributed, and bootstrapped confidence intervals can be generated based on the distribution of the obtained estimates (Hayes, 2018). Bootstrapping is especially useful when it comes to the estimation of indirect effects in mediation analyses. Parametric statistical tests rely on the assumption that the distribution of estimates across samples are normal, meaning that if we draw an infinite number of samples from a population, the distribution of obtained estimates is a normal distribution (Cohen et al., 2003). The indirect effect is a product of two effects, $a$ and $b$, and research has shown that the normality approach does not hold in analyses of indirect effects, resulting in biased estimates of the standard errors of the indirect effects (Muthén, 2011). Bootstrapping, however, does not rely on any assumptions on the shape of the sampling distribution of $ab$. With today’s computational power, it is customary to present all indirect effects obtained by the product-of-coefficients method with bootstrapped confidence intervals. Confidence intervals in the mediation analyses in Paper I and in the confounder analyses in Paper III included in this thesis were based on 5,000 bootstrap samples, and confidence intervals in the mediation analyses in the appendices of Paper II were based on 1,000 bootstrap samples.

The product-of-coefficients method is widely used and has several advantages over other available methods for assessing mediation. It is quite intuitive to understand, and models based on linear regression return unbiased estimates. The method also makes it possible to partial out effects of each mediator in models with multiple mediators. However, the method also has some drawbacks, the main drawback being that the estimates from the method will be biased with non-rare binary outcomes (more than 10%), because the estimates with and without the mediator in the model are no longer directly comparable. Including confounders in the model might also bias the estimates (VanderWeele, 2015). This criticism has been
addressed by researchers advocating the use of the counterfactual approach to mediation analysis.

The Counterfactual Framework

Unlike the product-of-coefficients method, mediation analyses in the counterfactual framework can handle categorical outcome and mediator variables, and the analyses in Paper II were conducted using this framework. Counterfactual mediation analyses return three different effect measures: the total effect (TE), the natural direct effect (NDE), and the natural indirect effect (NIE). The TE shows the change in the outcomes variable between the counterfactual outcomes of letting the total sample be in the exposure group and letting the mediator change to the value of the exposure group compared to letting the total sample be in the non-exposure group and keeping the mediator value to the level of the non-exposure group. The NDE shows the change in the outcome variable between the counterfactual outcomes of letting the total sample be in the exposure group but keeping the mediators to the value of the non-exposure group, compared to letting the total sample be in the non-exposure group and keeping the mediators to the value of the non-exposure group. The NIE shows the change in the outcome variable between the counterfactual outcomes of letting the total sample be in the exposure group and letting the mediator change to the exposure level, compared to letting the whole sample be in the exposure group and keeping the mediator as it was for the non-exposure group. In this thesis, the TE shows the increase in risk for physical fighting between the counterfactual outcomes of letting the total sample be from 2018 and allowing the mediator to change to the value from 2018 compared to letting the total sample be from 2015 and keeping the mediator value to the level from 2015. The NDE shows the increase in risk for physical fighting between the counterfactual outcomes of letting the total sample be from 2018, but keeping the mediator as it was in 2015, compared to letting the total sample be from 2015 and keeping the mediator as it was in 2015. The NIE shows the increase in risk for physical fighting between the counterfactual outcomes of letting the total sample be from 2018 and allowing the mediator to change to the value from 2018 compared to letting the total sample be from 2018 and keeping the mediator value to the level from 2015. As recommended in the literature, the analyses were conducted using probit regression (Nguyen, Webb-Vargas, Koning, & Stuart, 2016). Potential outcome probabilities were calculated based on the parameter estimates from the probit analyses, and results were presented as risk differences of these probabilities for the TE, the NDE, and the NIE.
Mediation analyses in the counterfactual framework have several advantages compared to traditional mediation analyses using the product-of-coefficients method, including methodological rigorousness when it comes to handling categorical variables and confounders, and the potential to handle mediator-outcome moderation (VanderWeele, 2015). However, the analyses are methodologically more complex and thereby not as accessible as traditional mediation analyses. Moreover, no method has been developed so far for identifying valid estimates of each single mediator in models containing multiple mediators (Nguyen et al., 2016). Analyses have also shown that traditional methods for conducting mediation analyses will return significant mediation effects also in models with interactions and nonlinearities, even though the effect estimates will not be entirely accurate (Valeri & Vanderweele, 2013).

### 3.4.3. Moderation Analyses

Moderation analyses were used in all three papers included in the thesis. Moderation is when the association between an independent and a dependent variable is contingent on the value of a third variable, e.g., when an identified association varies between girls and boys (Aiken & West, 1991; Hayes, 2018). In Papers I and II, potential gender differences in associations of predictors with violence were tested by means of moderation analyses. Several regression models were computed, with violent behavior as the dependent variable and each of the putative explanatory factors, gender, and interaction terms between the explanatory factor and gender as independent variables. A significant interaction term would imply that the association between the explanatory factor and violence differed between boys and girls, indicating the need to conduct separate analyses for boys and girls to obtain unbiased estimates. The analyses in Papers I and II were also conducted on the combined data from two surveys. The decision to use the data as a combined data set hinged on the assumption that associations between violence and putative explanatory factors did not change over time, and moderation analyses including violence as the dependent variable and each of the explanatory factors, survey year, and interaction terms between the explanatory factors and survey year were utilized to investigate this assumption.

In Paper III, moderation analyses were used to investigate whether the association between adolescent violence and adult life outcomes was affected by individual differences in intelligence. The assumption was that those scoring higher on the intelligence test might possess resources enabling them to better handle the impact of adolescent violence on adult outcomes, thereby mitigating negative effects. The results from the moderation analyses in
Paper III were of substantial importance for the argument of the paper, so the paper also included several techniques for further probing of identified effects. First, moderation effects from the analyses were presented with visual aids according to recommendations from Aiken and West (1991). Second, interaction effects were further probed using two different techniques, the Johnson-Neyman (JN) technique of regions of significance (Johnson & Neyman, 1936) and simple slope analyses of conditional effects estimated based on results from the moderation analyses (Hayes, 2018). When identifying a significant moderation effect in analyses, the JN technique can be used for continuous moderators to identify the areas along the continuum of the moderator where the moderator effect transitions from non-significant to significant at the $\alpha$ level of significance. The simple slope analysis identifies the significance of the moderator effect for selected values of the moderator variable, e.g., at the mean and at given standard deviations above and below the mean (Hayes, 2018).

3.4.4. Handling of Missing Data

Two sources of missing data in survey studies are item non-response and attrition. Item non-response refers to situations where respondents do not give an answer to specific questions throughout the survey. Non-response is usually more prevalent on items near the end of the questionnaire, but it can also vary according to the nature of the questions. In Paper I, the missing rates varied from 0.2% ($n = 18$) on the measure on class level to 3.8% ($n = 405$) on the measure of whether the respondent was living with both biological parents, and the missing rates in Paper II varied from 0.7% ($n = 357$) on the measure of age to 10.7% ($n = 4,958$) on the measure on use of social media. The missing rates in Paper III varied from 0.2% ($n = 2$) on the instrument measuring best friends’ conduct problems to 8.6% ($n = 93$) for the measure on migration background.

Attrition is a second source of missing data that relates specifically to longitudinal studies. Attrition is when respondents completely drop out from the study, resulting in missing data on all future data collections. Attrition might also happen intermittently in longitudinal studies, where respondents might participate in one round of the survey, skip the following, before again participating in the next one. The Young in Norway Longitudinal survey has a specific pattern of missing data, as depicted in Figure 1 in section 3.1.3 above. Missing data in the sample used in Paper III was partly induced by the study design, such as only inviting those who responded to the first two rounds of the survey at school to the T3 follow-up and including only boys in the analyses due to the usage of intelligence test scores from the National Conscript Service, but three sources of attrition may also be of relevance.
The first is drop-out from the survey during the follow-ups at T2, T3, and T4, the second is participants’ consent at T4 for their survey responses to be merged with information from official registers, and the third is having valid test data on the intelligence test from the National Conscript Service, which all may have impacted the composition of the final sample used in the study.

All analyses in the thesis were based on the full-information maximum likelihood (FIML) procedure, thereby utilizing what is considered to be state-of-the-art for handling of missing data (Schafer & Graham, 2002). Whereas traditional ordinary least squares estimation includes only complete cases in the analysis, the maximum likelihood procedure generates estimates based on all different missing patterns in the data material. This implies that the final estimates are based on all available data instead of only on observations with complete data (Enders, 2010). An assumption of the FIML procedure is that data are missing at random (MAR). Data are considered to be MAR when the probability of missing in the outcome variable $Y$ is completely accounted for by other variables included in the model. A second mechanism of missing data is missing completely at random (MCAR), where missingness is unrelated both to the $Y$ variable and to other measured data. A final mechanism of missing data is missing not at random (MNAR), where the probability of missing is related to the value on $Y$ and is not accounted for by other variables included in the model. Simulation studies have showed that FIML returns accurate estimates both for MAR and MCAR data, whereas estimates will be biased when data are MNAR (Enders, 2010).

Missing by design will in general cause data to be MCAR and is thereby unproblematic for future analyses. The dependent variables used in all three papers in this thesis, however, assess a behavior that is likely to be more prevalent in the same group of participants that has item-nonresponse throughout the survey. Thereby, the probability of missing is related to the value of $Y$, generating data where the most probable missing data mechanism is MNAR. In general, missing rates on the main instruments were low (1.8% to 3.7%), indicating that the estimates from the analyses were not severely affected due to missing data. Concerning attrition in Paper III, who consented to having their survey responses merged with information from official registers is likely not random, and we also know that participation in the assessment at the National Conscript Service was not completely random (Sundet et al., 2010). This may also generate MNAR data. The analyses therefore included several relevant confounding variables related to the probability of missingness, such as sociodemographic background, migration background, and school grades. By including relevant confounders in the analyses, the missing data patterns were closer to fulfilling the assumption of FIML on
MAR data, where missingness is completely accounted for by variables included in the models. According to Enders (2010), the most viable option for analyzing MNAR data is nevertheless a well-designed maximum likelihood analysis.

4. Results

4.1. Paper I

The analyses in the first paper included in this thesis showed a considerable decline in violence perpetration among Norwegian adolescents from 2007 to 2015, with an overall reduction in physical violence from 23.3% to 12.6% between the two surveys. The total amount of reported violence was equal for boys and girls. Characteristics of the reported acts still varied considerably by gender. Boys more often than girls reported hitting and kicking, whereas girls more often reported scratching, pulling hair, and slapping someone. Boys also reported more violent acts against acquaintances or unknown adolescents than girls, whereas girls more frequently reported using violence against adolescent acquaintances, romantic partners, or siblings.

Mediation analyses identified co-occurring declines in the frequency of alcohol intoxication and the number of alcohol-related problems as the most prominent explanatory factors in the decline in violence, particularly among boys. Declines in reported family violence and the proportion of participants ever having had a romantic partner were also related to the reduction in violence. Factors related to sociodemographic background, personality characteristics, and mental health problems did not contribute to explaining the decline in the perpetration of physical violence, nor did the use of illicit drugs or most factors related to social relationships.

4.2. Paper II

The second paper in this thesis identified a substantial increase in physical fighting among adolescents in Oslo from 2015 to 2018. Both the occurrence and the frequency of physical fighting increased significantly among boys and girls both in junior and in senior high school. In total, the rate of physical fighting increased from 16.7% to 22.4% in 3 years. Initial rates of physical fighting differed both according to gender and school level. Boys in junior high school were four times more likely than girls to report physical fighting; in senior high school the rates were three to one. Similarly, the rates of fighting were about 50% higher in junior than in senior high school for both genders.
Mediation analyses showed the rise in fighting to be related to co-occurring changes in several leisure activities, such as increasing time spent unsupervised by adults, rising digital media use, and rising cannabis use. Several included explanatory factors did not show co-occurring trends with physical fighting and could thereby not be explanatory factors in the trend, among them parental monitoring, participation in organized leisure activities, and alcohol intoxication.

4.3. Paper III

The analyses in the third paper in this thesis identified a distinct association between adolescent boys’ physical fighting and a range of unfavorable adult life outcomes in the realms of education, employment, and criminal activity. Adolescent fighting was related to educational attainment 21 years later, income, labor market marginalization, and being charged with violent and non-violent crimes. All associations apart from income retained their significance also after controlling for several relevant confounders, including both the boys’ own and their friends’ conduct problems, parental education, age, and migration background.

Confounder analyses further identified intelligence as a factor associated with differences in the initial level of adolescent physical fighting and differences in adult life outcomes. Including intelligence in the analyses explained between 7% and 28% of the observed association between physical fighting and four of the five outcomes in adult life, indicating both that other individual characteristics might be of importance for understanding the individual propensity of violence and that adolescent physical fighting might be directly associated with adult life outcomes through social processes such as stigmatization or labeling. Individual differences in intelligence also moderated the association between adolescent boys’ physical fighting and educational attainment 21 years later. Boys with higher intelligence did not report any negative effects of adolescent physical fighting, whereas boys with lower intelligence reported a distinct and negative impact of fighting on educational attainment.

5. Discussion

5.1. General Discussion of Findings

The overall aim of this thesis was to increase knowledge on societal trends in adolescent violence, with a special emphasis on understanding trend changes and on adult life outcomes for young perpetrators of violence, highlighting mechanisms responsible for the association between violence perpetration in adolescence and outcomes in adulthood. The first two papers
included in this thesis provided novel information on several important individual level factors related to shifting trends in adolescent violence, and the third paper contributed knowledge on the complex interplay between adolescent violence, intelligence, and adverse adult outcomes in the realms of education, employment, and crime. The following section provides a discussion of the findings in light of previous research on the two topics.

5.1.1. Understanding Time Trends in Adolescent Violence

The analyses in this thesis show shifting trends in violence among Norwegian adolescents, with a marked decrease in violent behavior from 2007 to 2015 and an increase in physical fighting from 2015 to 2018. Previous research has pointed to a lack of knowledge on important individual level factors for understanding shifting trends in adolescent violence (see e.g., Baumer et al., 2018; Tcherni-Buzzeo, 2019). The findings in this thesis underscore the importance of considering alcohol and substance use, the use of digital media, and adult supervision of leisure time activities when investigating trends in violence. The research field has also been criticized for lacking a theoretical rationale of suggested explanatory factors in time trends (Baumer & Wolff, 2014). This section delineates how the identified explanatory factors in trends in violence relate to three suggested causal mechanisms: criminal propensity, criminogenic settings, and social control.

An important factor highlighted by Tcherni-Buzzeo (2019) for understanding “the great American crime decline” was a co-occurring decline in adolescent alcohol use. The analyses in Paper I in this thesis confirm that a decline in problematic alcohol use is one of the main explanatory factors contributing to a marked decline in physical violence among Norwegian adolescents. Longitudinal research on risk factors for adolescent violence has also related alcohol use to an increased risk of violent behavior (Tomlinson et al., 2016), further strengthening the argument that problematic alcohol use is important both as an individual level risk factor for adolescent violence and as an explanatory factor in shifting trends at the societal level. Alcohol use is hypothesized to be especially important for the individual propensity for violence due to pharmacological effects of alcohol, but the amount of time spent in criminogenic settings might also be influenced by the overall level of alcohol use among adolescents. However, the increase in adolescent physical fighting identified in Paper II in the thesis took place without a co-occurring increase in alcohol use, thereby warranting other explanations of the trend change. Contrary to the results for alcohol use, the decline in violence observed in Paper I co-occurred with an increase in illicit drug use among boys, indicating that illicit drug use cannot be an explanatory factor in the decline in violence. The
use of cannabis, however, is one of the most prominent explanatory factors in the increase in physical fighting among Oslo adolescents in Paper II. When it comes to understanding adolescent violence, the role of cannabis use is a debated issue. Previous research has investigated the pharmacological effects of cannabis use on violent behavior, stressing among other things cognitive influences of use, but evidence of a causal association has not been provided up to now (Liu & Petras, 2017). Others claim that associations between cannabis use and violence are mainly caused by an antisocial lifestyle promoting both violence and drug use in general (Barthelemy et al., 2016). Accordingly, the impact of cannabis use on the individual propensity for violence is unclear, but it is likely related to time spent in criminogenic settings. A possible explanation of the differing findings in Papers I and II in the thesis concerning the use of illicit drugs is that simultaneous changes in other relevant factors may have overshadowed the negative impact of illicit drug use on trends in violence in Paper I. Another possibility is that the settings involving use of cannabis and other illicit drugs differ in the two studies, causing an increase in illicit drug use to co-occur with declining levels of violence in one paper and with an increase in other analyses, but no evidence points to changes in the social surroundings of illicit drug use in the time period investigated in the thesis.

A second issue raised in previous research on trends in adolescent violence relates to the role of digital media. A suggested mechanism is that today’s adolescents spend time on digital media instead of in situations with an increased risk of violence (Arnett, 2018; Finkelhor, Shattuck, Turner, & Hamby, 2014; Tcherni-Buzzeo, 2019). Significant lifestyle changes due to the use of digital media have also been suggested as a viable explanation of a general decline in risk behavior among adolescents in recent decades (Arnett, 2018). With the fast-changing nature of the phenomenon, it is a difficult matter to study empirically, mostly due to a lack of suitable data. The surveys included in Paper II in the thesis were conducted fairly close in time, enabling analyses of trends in digital media use in relation to an increase in adolescent physical fighting. The analyses revealed that a co-occurring increase in digital media use is related to an increase in physical fighting for both genders, thus not supporting the hypothesis that digital media use should contribute to declining levels of adolescent violence. However, other researchers have suggested that the displacement effect of digital media on adolescent problem behavior should naturally diminish in the years to come, because a large amount of the media usage now takes place on portable platforms such as smartphones, making it unnecessary for young people to stay at home to keep up their use (Green, 2016). Combining this assumption with social media’s possibility as an arena for
bullying and conflict (Cannon et al., 2015), the positive association between increases in digital media use and in adolescent violence might be expected. Although possible causal mechanisms associating digital media use with adolescent violence are unknown so far, a line of reasoning might be that extensive use has a major impact on the time adolescents spend in criminogenic settings, thereby contributing to declining levels of violence, but that the use in itself is related to an increase in violent propensity when it happens in settings prone to violence. Researchers have identified similar mechanisms concerning the association between time spent on in-person social interaction and digital media use, where time trends show less in-person social interaction and more social media use, whereas in-person social interaction and social media use at the same time are positively correlated on an individual level (Twenge, Spitzberg, & Campbell, 2019). This is a pressing matter to examine in future investigations.

A third aspect studied in this thesis related to shifting trends in adolescent violence was unstructured peer socialization and the absence of adult supervision in these situations. The societal level of unstructured activities among adolescents impacts the number of possible meeting points for adolescents hanging out without any specific purpose (Osgood & Anderson, 2004), which would translate into an increase in time spent in criminogenic settings (Baumer & Wolff, 2014). Accordingly, the analyses in Paper II in the thesis reveal associations between adolescent violence and increases in time spent outside of home with friends and school truancy, respectively. Even though the item on hanging out with friends included in the analyses did not specify that the time was spent without adults present, it is a reasonable assumption that time spent outside of home with friends is most likely also time spent without adult supervision. With regards to the suggested causal mechanisms from Baumer and Wolff (2014), this would also mean less social control of adolescent activities. Paper II included several other features hypothesized to be indicators of the overall level of adult supervision of adolescent leisure time activities. An instrument covered participation in organized leisure activities, which was hypothesized to be an arena where activities happen under adult supervision, and a second instrument covered the level of parental monitoring.

The frequency of the two aspects did not change between the two surveys, so they therefore cannot be explanatory factors in the increase in adolescent physical fighting.

The first paper in this thesis also included several instruments measuring other aspects related to lifestyle and social relationships. The aspects were hypothesized to influence the individual propensity for violence, through transfer of social norms and values. The findings show that co-occurring changes in being exposed to family violence and having had a
romantic partner are related to changes in the societal level of violence. A reduction in exposure to family violence is particularly important for understanding the decline in the societal level of violence in girls. Several variables on parenting style and availability of social resources are unrelated to changes in the violence levels.

In addition to identifying several areas of significant importance for understanding trends in the societal level of adolescent violence, the thesis also investigated factors from other areas that did not contribute in the same manner. The first paper included factors hypothesized to influence mainly the individual propensity for violence, such as sociodemographic background, personality factors, and mental health; the findings do not show any of them to contribute as explanatory factors in trends in adolescent violence. The most common reason for not contributing to understanding the change in adolescent violence was not showing co-occurring trends. Mental health was identified as a possible suppressing factor, as the level of mental health problems increased at the same time that the societal level of violence declined. Accordingly, had mental health problems similarly decreased along with the decline in level of violence, the decrease in violence might have been even more profound.

The analyses in this thesis do not include several important large-scale societal changes hypothesized to be essential for understanding trends in crime and violence, such as increased securitization of modern societies (Farrell et al., 2014), changes in law enforcement and policing strategies (Blumstein & Wallman, 2005), economic conditions (Rosenfeld, 2009), or lead exposure (Nevin, 2007; Reyes, 2007). It is therefore not surprising that the explanatory factors included in the analyses do not completely account for the observed trends in adolescent violence. However, the analyses provide an example of how repeated cross-sectional surveys on an individual level can be used to gain knowledge on important factors for understanding trends in violence not available in research using data on an aggregated societal level. Concerning hypothesized causal mechanisms for explaining crime trends, individual level data mostly contributes to increasing our understanding on how the individual propensity for violence changes over time. But it may also provide relevant information on both criminogenic settings and social control, such as on how trends in adolescent leisure activities or adult supervision influence the overall societal level of violence. The analytic strategy in this thesis also highlights how using a variety of different data sources may provide novel information on an empirical topic that already has seen widespread attention in existing research.
5.1.2. Adolescent Physical Fighting and Adult Life Outcomes

The analyses in Paper III in this thesis identify distinct associations between adolescent boys’ physical fighting and negative adult outcomes in the realms of education, employment, and crime. The results are in line with previous studies that found associations between other forms of violent conduct in adolescence and a variety of educational and employment outcomes in adult life (Kim, 2018; Tanner et al., 1999; Wilczak, 2014), as well as studies that have associated crime and other forms of problem behavior to a range of adverse adult outcomes (Bernburg & Krohn, 2003; Lanctôt et al., 2007; Makarios et al., 2017). The associations between physical fighting and adult outcomes were also controlled for possible confounding with other forms of conduct problems of the participants themselves and their best friends and with parental education to account for differences in family background. Including control variables in the analyses reduced the associations between adolescent physical fighting and all adverse adult outcomes, but physical fighting was still significantly related to four out of five measured outcomes. It thus seems that adolescent physical fighting may be related to adult outcomes through mechanisms beyond what is caused by problem behavior in general.

The mechanisms in the association between adolescent crime and problem behavior and adult outcomes is a debated issue in previous research, with the main theoretical traditions either attributing the associations to differences in stable, individual characteristics or viewing them as effects caused by societal reactions to the adolescent act in itself (Nagin & Paternoster, 2000). Paper III investigated whether mechanisms suggested for understanding outcomes of crime and problem behavior in general also could be used for understanding outcomes of adolescent boys’ physical fighting. The paper particularly investigated the complex interplay of adolescent physical fighting, intelligence, and adult outcomes in the realms of education, employment, and crime. A main inference from the analyses is that the mechanisms suggested for understanding associations between problem behavior in general and adult life outcomes are also in play in the association between physical fighting and adult outcomes. Whereas research has particularly emphasized the importance of self-control for understanding both the individual propensity for adolescent crime and delinquency (Burt, 2020) and adverse outcomes in a variety of areas of adult life (Robson et al., 2020), the analyses in Paper III point to intelligence as an important factor to consider when investigating associations between adolescent violence and adult outcomes.

The analyses reveal two mechanisms in play when examining the interplay of adolescent physical fighting, intelligence, and adult outcomes. First, intelligence was
considered as a confounding factor in the association between physical fighting and adult outcomes. This mechanism is analogue to the hypothesized impact of self-control on associations between crime and adult outcomes (Gottfredson & Hirschi, 1990). As expected, the findings show that intelligence is a confounding factor in several of the analyzed associations between physical fighting and adult outcomes, even though it only partially accounts for the associations. The remainder of the associations can probably be partially attributed to other factors related to the individual propensity of violence and partially to direct associations due to societal reactions such as labeling processes or snares. Self-control was not included in the analyses and could accordingly be an important factor contributing to individual heterogeneity, but personality factors may also play a vital role in this respect (Caspi et al., 1994; Makarios et al., 2017). It is important to bear in mind that lacking one or more possible sources of individual heterogeneity may influence the analytic results if the sources are correlated, so future studies should aspire to include several sources of individual heterogeneity in common analyses. Including multiple sources of individual heterogeneity may also strengthen conclusions regarding a possible direct effect of adolescent violence on adult outcomes, as the analyses in Paper III unfortunately cannot separate direct effects from remaining effects related to heterogeneity in factors not included in the analyses. However, the overall interpretation of the results from this thesis in combination with existing research renders it likely that negative long-term outcomes of adolescent violence are caused both by factors related to the individual propensity for violence and by societal reactions working as building blocks in stages of cumulative disadvantage for future life success.

The third paper also covered possible moderating effects of intelligence on associations between fighting and adult outcomes. The aim was to investigate whether the long-term impact of adolescent fighting on adult outcomes varied according to individual differences in intelligence, thereby either lessening or enhancing the potential consequences of adolescent violence. The analyses reveal a moderating effect of intelligence on educational outcomes, where boys with higher intelligence reported no negative effects of adolescent physical fighting on their obtained education level 21 years later, whereas boys with lower intelligence reported a distinct and negative effect of adolescent fighting. Cognitive resources might thus foster resilience, enabling perpetrators of violence to cope more adequately with the aftermaths of their adolescent acts. No moderating effects were identified for the remaining four outcomes. A similar mechanism was covered by Makarios et al. (2017) in a study investigating whether associations between adolescent delinquency and adult education and employment varied according to individual differences in personality factors and vocational
aptitude—a test of cognitive ability. Makarios et al. (2017) concluded that vocational aptitude moderates some of the analyzed associations, and that individuals with a low vocational aptitude experience more profound negative effects of their adolescent acts on outcomes in adult life. Evidence up to now thus indicates that factors related to the individual propensity for violence may provide individuals with resources that enable them to cope with adult life outcomes related to the violent acts, generating individual differences also in such outcomes.

5.2. Methodological Considerations

The findings in this thesis must be interpreted in relation to several methodological strengths and limitations. A main strength of the thesis is the use of nationally or regionally representative samples with fairly high response rates in all of the analyses. In particular, having access to repeated cross-sectional data measuring both trends in adolescent violence and putative explanatory factors at an individual level is a scarcity in current research. Moreover, Paper III utilized high quality data based on adolescent self-reports, intelligence test data from the Norwegian National Conscript Service, and data from official registers on adult life outcomes. The use of data from multiple sources strengthens the inferences from the study. Nevertheless, several methodological considerations also impact the interpretation of the results of the study, among them aspects related to causal inference and confounding, representativeness and generalizability, and measurement issues.

5.2.1. Causal Inference and Confounding

Papers I and II in this thesis reveal several co-occurring trends in factors relevant for understanding trends in adolescent violence, but no causal inferences can be inferred based on the utilized analyses. Due to the cross-sectional nature of the data material used in the papers, the analyses only reveal co-occurrence and not temporal order of the included trends. For example, the statistical model in Paper II assumed that an increase in leisure time spent unsupervised by adults contributed to an increase in physical fighting, but the statistical model could not exclude the possibility of the association being in the opposite direction and that an increase in physical fighting caused an increase in leisure time spent unsupervised by adults. Hypothetically, an increase in fighting could cause adolescents to become more socially distanced from their parents or to be evicted from organized activities, which could explain the observed association between co-occurring increases in fighting and unsupervised leisure time. The thesis has aimed to include associations where theoretical assumptions make it more likely that the included factor is influencing the societal level of violence rather than the
other way around. It is unlikely that changing societal levels in adolescent violence would lead to changes in substance use, even though the possibility cannot be excluded with the analyses used in this thesis. Nevertheless, implying causal inferences and directionality based on the analyses in Papers I and II in the thesis would be too strong an assumption.

A second issue in Papers I and II related to causal inference is the possibility of confounding factors influencing the observed associations. Unmeasured explanatory factors may influence both trends in the included explanatory factors and the societal level of adolescent violence, generating spurious associations. An important factor in this respect is discussed in Paper I: time spent on digital media. An interpretation of the findings in Paper I is that declines both in problematic alcohol use and in adolescent violence are caused by an increase in time spent at home using digital media, and that including this factor in the analyses would render the observed association insignificant. Large-scale societal trends may also influence associations observed in Papers I and II, such as changes in economic opportunities (Rosenfeld, 2009), policing strategies (Blumstein & Wallman, 2005), or lead poisoning (Nevin, 2007; Reyes, 2007). The samples used in Papers I and II were evaluated regarding a range of background characteristics to ensure comparability, but this does not account for possible confounding of unmeasured variables.

An important consideration in Paper III related to confounding is the appropriate use of control variables in the analyses. A first dilemma is whether it is appropriate to include participation in other forms of problem behavior as a control variable. Adolescents using violence will often be more prone to report other forms of delinquency as well; this complicates the aspect of identifying whether violence in itself has associations with negative later life outcomes or whether a delinquent lifestyle in general is what is really of importance. Given a positive correlation between violence and other forms of problem behavior, chances are that an effect of violence on adult outcomes will be stronger if problem behavior is not included as a control variable. By including problem behavior in the analyses as a control variable, however, we might also experience that the complete effect of adolescent violence is rendered insignificant, due to the correlation between problem behavior and violence. Tanner et al. (1999) conducted analyses on the impact of adolescent delinquency on educational and employment outcomes, where violent delinquency was included simultaneously with other forms of delinquency, such as school truancy, drug use, property crime, and police contact. All forms of delinquency were initially associated with poor outcomes in adult life, but the majority did not retain their significance when they were included in a joint analysis. Controlling for problem behavior in the analyses might strengthen the possibility of
identifying adverse adult life outcomes that are not caused by problem behavior in general but are related to physical fighting in particular. To account for this correlation, the associations between physical fighting and adult outcomes in Paper III in the thesis were estimated both before and after including the respondents’ own and their friends’ participation in other forms of problematic conduct in the analyses. As expected, the observed associations between physical fighting and adult outcomes were stronger before including problem behavior in the analyses, but they also retained their significance after including the control variables. A second consideration regarding control variables relates to environmental and familial influences. Kim (2018) conducted analyses on associations between adolescent delinquency and educational outcomes using sibling pairs, thereby controlling for both measured and unmeasured environmental influences, causing the initial association between violent delinquency and educational outcomes to no longer be significant. Paper III in the thesis therefore included information from official registers on parental education to account for the impact of family background on associations between physical fighting and adult outcomes, even though the use of sibling analyses would be methodologically stronger (Kim, 2018). According to the findings both in this thesis and of Kim (2018) and Tanner et al. (1999), a proper selection of confounding factors in the analyses is important when considering outcomes of adolescent violence.

5.2.2. Representativeness and Generalizability

Representativeness refers to whether surveys provide an accurate image of the population intended to be measured. All the surveys included in this thesis were school based, so adolescents not attending school were not given the opportunity to participate. Almost all Norwegian adolescents attend junior high school, and the attendance rate was 93.4% in senior high school in 2019 (Statistics Norway, 2020a). Even though the attendance rate for Norwegian high school is high, the adolescents who attend school become more and more selected throughout high school. This issue is especially important when it comes to the UngVold surveys used in Paper I. Even though the surveys included a representative sample of Norwegian adolescents attending the final year of senior high school, the sample is not representative of Norwegian youth in the attending age group. Two important groups were not invited to participate in the survey: those who had dropped out of high school before the final year and those who were in an apprenticeship in vocational education as their final high school year. It is not possible to provide an exact number on the percentage of adolescents in a given age group that attends general studies in the final year of Norwegian high school, but
estimates based on numbers from Statistics Norway indicate that it is somewhere between 60% and 70% (Statistics Norway, 2020b; Statistics Norway, 2020c), meaning that 30%–40% of Norwegian adolescents in the given age group were not part of the initial survey sample. Previous research has identified higher levels of problem behavior among both high school dropouts (Maynard, Salas-Wright, & Vaughn, 2015) and students attending vocational studies (Holmberg & Hellberg, 2007), indicating that the estimates of adolescent physical violence might have been even higher if these groups had been included in the surveys. The issue is less profound when it comes to the Young in Oslo surveys used in Paper II, even though approximately 2 out of 10 adolescents aged 13 to 18 living in the municipality of Oslo did not participate in the surveys. The Young in Norway Longitudinal study used in Paper III also started with a representative sample of Norwegian youth, but attrition analyses presented in section 3.1.3 above show that the sample included in Paper III was older and reported higher levels of conduct problems than the initial sample. The process of only contacting those who answered the T1 and T2 questionnaires at school for the T3 follow-up is not likely to have affected the final survey sample. The only selection criterion was not having changed schools from T1 to T2, and it was thereby not related to individual characteristics potentially influencing the composition of the sample. The reliance on getting consent to merge survey responses with data from registers, however, might be a source of bias, if the willingness to consent is unequally distributed in different social groups with unequal susceptibility to violence. Moreover, although most Norwegian men did attend the National Conscript Service examination of persons liable for military service at the time of the survey, several characteristics possibly related to violent propensity are reasons for not attending, such as imprisonment, severe illness, functional disorders, and working abroad or at sea (Sundet et al., 2010). Hence, the final T4 sample from Young in Norway Longitudinal that includes data from official registers might not be entirely representative of Norwegian high school students. In total, representativeness is probably best for the surveys utilized in Paper II in the thesis, especially for the junior high school sample. The surveys used in Paper I are fairly representative of students attending the final year of high school in Norway but not of Norwegian 18–19-year-olds in general. A reasonable assumption is that the overall level of problem behavior would be higher when sampling all adolescents in a given age group compared to only those who attend school (Maynard et al., 2015), meaning that the analyses in all three papers in the thesis would tend to underestimate rather than overestimate the overall level of violence among Norwegian adolescents.
Generalizability refers to the validity of the results in contexts other than the one that is studied. The specific Norwegian context of all the included surveys is of importance in this respect. The issue is particularly discussed in Paper III in the thesis, as associations between adolescent violence and adult outcomes might be affected by aspects characteristic of Norwegian society today, such as Norway being a country with a particularly low violence rate and a tight social security network. The context of the surveys might also impact whether the individual level factors included in Papers I and II would contribute to explain trends outside of Norway. However, all putative explanatory factors were included either based on theoretical suggestions and previous research on crime trends (Baumer et al., 2018) or on relevant risk and protective factors on an individual level (Farrington et al., 2017; Lösel & Farrington, 2012), which strengthens the inference of the results. A second aspect related to generalizability relates to change over time. The first wave of the Young in Norway Longitudinal survey used in Paper III in this thesis was conducted in 1992, and a range of relevant contextual factors have changed in the almost 30 years since. Accordingly, we do not know whether adolescent physical fighting today will be similarly related to adult life outcomes 30 years into the future. This is a general challenge with prospective longitudinal surveys, as measurement necessarily must go back in time to enable analyses of outcomes in later periods of life. Ideally, longitudinal surveys should be supplemented with surveys of new generations—which is known as a cohort sequential design—providing the opportunity to strengthen inferences of observed associations by identifying them in more than one cohort. A cohort sequential design also makes it possible to separate age effects from cohort and period effects. Unfortunately, this is also a very costly and time-consuming form of research.

5.2.3. Measurement Issues

All of the analyses in this thesis were based either completely or partly on adolescent self-reports, possibly inducing what is known as common method variance. Common method variance is a source of bias caused by only using information from one source in the analyses, which could inflate observed associations. In an ideal world, all constructs should be measured using information from several sources, such as parents of the participating adolescents, teachers at school, or official registers, in addition to self-reports, to minimize the impact of relying on information from a single source. This problem was partly alleviated in Paper III in the thesis, as it included both information from official registers and intelligence test scores from the Norwegian Conscription Service.
The measurement of several of the included constructs can also be questioned. The instrument measuring physical fighting in Paper II was changed over time, from two items assessing physical fighting with and without weapons to a single item assessing physical fighting overall, which can be an obvious source of bias. By changing the wording of the items, it is not possible to guarantee that the same phenomenon was measured at the two time points. However, all but seven of the respondents who reported physical fighting with a weapon in the first survey also reported fighting without a weapon, which indicates that the single item would also capture close to all fighters. The respondents may still have interpreted physical fighting somewhat differently when asked a single question compared to being asked two questions, but police reports also corroborate the development identified in the surveys (City of Oslo and Oslo Police District, 2019). In total, the evidence points towards a valid assessment of physical fighting also when combining two items into a single instrument.

A second issue relates to the use of single items for measuring different phenomena. Several of the explanatory factors in adolescent violence in Papers I and II were based on one single item in the questionnaire, such as leisure time spent at home and out with friends and exposure to family violence, although classical methodological literature highlights the importance of using multidimensional indicators to increase reliability. More recent methodological studies have still found that measurement based on single items might be both reliable and valid (see e.g., Dollinger & Malmquist, 2009). Finally, the wording of some of the included instruments is not completely free of interpretation. The conclusion in Paper II relies heavily on the assumption that leisure time spent unsupervised by adults affects violence perpetration, but the item measuring leisure time spent out with friends does not state explicitly that the time was spent without adults present. Overall, the thesis still mostly relies on high-quality and well-designed instruments, providing a sound basis for the provided conclusions.

5.3. Implications and Future Directions

The findings in the first two papers of this thesis have both conceptual and methodological implications for future research. First, the thesis raises awareness of the importance of co-occurring trends in individual level factors for understanding shifting trends in adolescent violence. Even though aggregate changes in larger societal structures might be vital for understanding long-term trends in violence, changes in behavioral factors closer to the individual might be just as important to consider. The analyses also identifies several promising factors for understanding trends in adolescent violence that should be further
scrutinized in future research, among them the role of substance use, digital media, and adult supervision. Concerning digital media in particular, the co-occurrence of increases in aggregated use on a societal level and a positive correlation with violence on an individual level is an important issue for future investigation. Second, the thesis highlights the importance of collecting and utilizing repeated cross-sectional surveys to increase our understanding of co-occurrence in trends at an individual level, something that has also been highlighted by other researchers (Baumer et al., 2018). Repeated cross-sectional surveys do not enable analyses of causal associations and directionality, but the findings in this thesis illustrates that such designs can still provide important knowledge. Third, the thesis employs a long-established methodological approach, mediation analyses, in a new manner: to investigate co-occurrence in trends. This methodological approach can be profitable for future studies on trends in a variety of phenomena. By utilizing the counterfactual approach to mediation analyses in one of the included papers, the thesis also provides a blueprint for conducting trend analyses on dichotomous outcomes.

Several important implications for future research can also be derived from the third paper of the thesis. First, the thesis identifies long-term associations between one of the most common acts of violence among adolescents—physical fighting—and negative adult outcomes in the realms of education, employment, and crime. Research often focuses on more severe acts of violence, but the findings in this thesis provide evidence that associations between less severe forms of violence and adult outcomes should also be considered in this respect. Second, the thesis substantiates that theoretical perspectives on mechanisms of the association between adolescent crime and adverse outcomes in adult life are likely to be valid also for understanding associations between adolescent physical fighting and adult outcomes. Future research should therefore consider both differences in individual propensity and possible direct effects of adolescent violence on adult life outcomes. Third, the findings highlight individual differences in intelligence as an important factor related to individual propensity for violence. Future studies on associations between adolescent violence and adult life outcomes should therefore include a measure of cognitive ability. Finally, the findings in the thesis emphasize the importance of considering a complex interplay of factors related to the individual propensity for violence and its association with outcomes in adult life. Especially the findings related to moderation could be of relevance for studies on the outcomes of other aspects of adolescent problem behavior and investigate, for example, how individual differences in personality traits or self-control may intensify the negative consequences of adolescent problem behavior for adult life outcomes.
The thesis also highlights several important areas related to youth work in general and violence prevention work in particular. The co-occurring decreases in violence and problematic alcohol use observed in Paper I emphasize the importance of considering substance use when working with adolescent problem behavior, as problematic substance use among adolescents is also highly related to other forms of problematic conduct. The analyses in Paper II further substantiate this claim by identifying an increase in cannabis use as one of the main explanatory factors in the increase in physical fighting. Paper II further points to leisure time activities as an important preventive measure against adolescent violence, especially access to leisure activities with adult presence. The findings on the role of digital media for understanding trends in violence also underlines that youth workers need to be involved in adolescents’ digital life for understanding changes that occur over time. Finally, the results of Paper III are a reminder that even what would seem to be trivial acts of violence during adolescence, such as physical fighting, may be related to serious and long-term adverse outcomes in adult life. To alleviate this, youth workers, parents, and other adults in adolescents’ lives need to acknowledge that even minor participation in problematic conduct might have implications for late life opportunities and should be handled accordingly when it happens. Physical fighting is also a fairly common act of violence among adolescent boys, so that the identified long-term negative effects of fighting are of particular interest in violence prevention work.

6. Conclusions

This thesis has investigated two key questions in adolescent violence research: How can we understand time trends in the prevalence of adolescent violence? Is adolescent violence related to adverse outcomes in adult life? The findings highlight the importance of considering individual level factors for understanding shifting trends in adolescent violence, especially understanding how trend changes are related to co-occurring trends in substance use, digital media use, and adult supervision. The analyses in the thesis included periods with a decline and periods with an increase in adolescent violence. The decline in adolescent violence is particularly strongly related to a co-occurring decline in problematic use of alcohol, and the increase in violence is related to simultaneous increases in the use of digital media, the amount of leisure time spent without adult supervision, and cannabis use. The thesis has further increased our knowledge on the association between one of the most common acts of violence among adolescents—physical fighting—and adult life outcomes in the realms of education, employment, and crime, with a special emphasis on the role that
individual differences in intelligence plays in this respect. Adolescent physical fighting is related to adverse outcomes in all investigated areas of adult life, and most of the associations retained their significance also after controlling for several relevant confounding factors, such as intelligence, parental education, conduct problems, and friends’ conduct problems. This finding draws attention to adolescent physical fighting as a possible cause of serious and long-term problems in adult life. Intelligence was still associated with both adolescent fighting and adverse adult life outcomes, even after control for covariates, indicating that individual differences in intelligence is an underlying explanatory factor of parts of the observed statistical associations from adolescent violence to adult life outcomes. The long-term outcome of adolescent physical fighting for educational attainment also differs according to intelligence, where boys with lower intelligence experience more profound consequences than boys with higher intelligence. Taken together, this thesis provides new knowledge on why the societal level of violence changes over time and on mechanisms in the association between adolescent violence and adverse outcomes in adult life. It is hoped that this knowledge can be used to mitigate the substantial costs of adolescent violence, for both society worldwide and for the individuals involved.
References


Errata

Corrigendum submitted to Aggressive Behavior concerning Paper III:


Due to a coding error in the analyses, presented estimates on confounding effects of intelligence in one paragraph in the results section were incorrect. We apologize for the error and any problem it may have caused.

The original paragraph was:

For two of the five outcomes, intelligence was a significant confounder in the relationship between adolescent boys’ physical fighting and adult outcomes. Regarding violent crime, the confounder effect of intelligence was estimated to −0.04 (p = .030; 95% CI [−0.08; −0.01]). This is equal to 11.6% of the total estimated effect. Labor market marginalization showed a similar coefficient, with a confounder effect of −0.03 (p = .027; 95% CI [−0.07; −0.01]), equaling to 8.1% of the total estimated effect. Hence, individual differences in intelligence accounted for some part of the negative association of boys’ physical fighting with adult life outcomes. Intelligence was not a significant confounder for being charged with a crime (confounder effect = −0.01; p = .053; 95% CI [−0.03; 0.00]), education level (0.00; p = .073; 95% CI [0.00; 0.01]), and income (−0.01; p = .190; 95% CI [−0.02; 0.00]).

The corrected paragraph is:

For four of the five outcomes, intelligence was a significant confounder in the relationship between adolescent boys’ physical fighting and adult outcomes. Regarding being charged with a crime, the confounder effect of intelligence was estimated to 0.09 (p = .008; 95% CI [0.04; 0.17]). This is equal to 16.2% of the total estimated effect. The confounder effect for violent crime was calculated to 0.10 (p = 0.041; 95% CI [0.03–0.22], equaling to 6.6% of the total estimated effect. For labor market marginalization, intelligence induced a confounder effect of 0.13 (p = 0.017; 95% CI [0.05; 0.26]), equaling to 9.4% of the total estimated effect. For the obtained education level, the confounding effect of intelligence was
estimated to $-0.07$ (p = .002; 95% CI $[-0.11; -0.03]$), equaling 28.4% of the total effect. Intelligence was not a confounder in the relationship between adolescent physical fighting and income in young adulthood.

As a result of these corrections in the results, one sentence in the discussion section is also incorrect.

The original sentence was:

However, the confounder effects were found for only two of the five included outcomes and were rather small (8%–12% of the total effect), thereby indicating that intelligence may be one of a multitude of confounders of the relationship between adolescent boys’ physical fighting and future life outcomes.

The correct sentence is:

The confounder effects were found for four of the five included outcomes but accounted only for parts of the observed associations (7%–28% of the total effect), thereby indicating that intelligence may be one of a multitude of confounders of the relationship between adolescent boys’ physical fighting and future life outcomes.

We wish to emphasize that the fundamental interpretation of the study results has not changed and that all other figures reported in the text and tables are correct.
Papers I–III

Lars Roar Frøyland1 · Tilmann von Soest1,2

Abstract Most research on trends in physical aggression has shown declining levels among adolescents during the past two decades. However, few studies have attempted to explain such time trends. Based on two representative cross-sectional surveys of students in the final year of high school in 2007 (N = 6631; 58.8% girls) and 2015 (N = 4145; 60.3% girls), this study reports a substantial decline in physical aggression among Norwegian adolescents. Moreover, mediation analyses show that declining levels in problematic alcohol use and family violence during the same period are plausible explanations for some of this reduction. The results are discussed in light of contemporary changes in socialization of adolescents, and implications for violence prevention are presented.

Keywords Aggression · Violence · Perpetration · Time trends

Introduction Late adolescence and early adulthood are the periods of life when people are most likely to perpetrate physical aggression (Loeber and Farrington 2014). Perpetration of aggressive acts in adolescence can have long-lasting negative impacts that affect later life. For example, perpetrators have a greater risk of dropping out of college compared with other youth (Jennings et al. 2011), and they more often participate in later violent and nonviolent crimes (Gilman et al. 2014). Furthermore, problem behavior in general, which includes physical aggression, is related to future economic difficulties, drug problems, and poor mental and physical health (Odgers et al. 2008). Acts of aggression can also injure other people, as well as increase the risk of future problems for the victims, including internalizing problems (Reijntjes et al. 2010), externalizing problems (Reijntjes et al. 2011), involvement in crime and deviance (Macmillan 2001), and problems adjusting to school and work settings (Macmillan 2001).

Given the adverse consequences of adolescent aggression for both perpetrators and victims, it is important to investigate time trends in the perpetration of aggressive acts and factors that may influence such trends. However, even though some studies have examined time trends in physical fighting (e.g., Kann et al. 2016; Pickett et al. 2013), research on time trends in broader measures of physical aggression is sparse. An increased understanding of explanatory factors of trends in aggression may improve the tailoring of measures to prevent or reduce such acts among adolescents. This article investigates whether the prevalence of physical aggression perpetrated among Norwegian adolescents changed in the period from 2007 to 2015, and examines whether trends in potential risks and protective factors of physical aggression may explain such changes. Furthermore, gender differences in the types of aggressive acts and the victims of aggression are explored.

Time Trends in Physical Aggression

The most comprehensive data on time trends in physical aggression comes from the cross-national Health Behaviour in School-Aged Children (HBSC) study among 11–15-year-
olds in 30 countries in Europe and North America. The analyses showed decreases in the incidence of physical fighting across three surveys conducted in 2002, 2006, and 2010 in 19 of the 30 participating countries, whereas stable levels were found in eight countries, and only three countries showed increases (Pickett et al. 2013). Declining trends were also found in a US study showing that the proportion of high school students involved in physical fights decreased from 42.5 to 22.6% from 1991 to 2015 (Kann et al. 2016). Only two self-report studies measured time trends using other measures of aggression than involvement in physical fights. Among US children and adolescents aged 6–17 years, Finkelhor et al. (2014) found a 46% reduction from 2003 to 2011 in the proportion of those who had hit, slapped, or pushed other children. Furthermore, a Swedish study showed a decline from 1995 to 2005 in the proportion of 15-year-olds reporting having hit someone in the previous 12 months, from 11.8 to 8.8% among boys and 3.8 to 2.5% among girls (Svensson and Ring 2007). As such, studies in general show reductions in the level of physical aggression perpetrated among adolescents during the last two decades. However, rather narrow measures of aggressive acts were used in most studies, providing limited information about time trends in different aspects of physical aggression or the victims of such behavior. The present study provides data about this issue in a Norwegian context.

Risk and Protective Factors for the Perpetration of Physical Aggression

When time trends in the perpetration of aggression have been identified, the next step is to examine how such trends may be explained by changes in the prevalence of factors that are supposed to increase the risk of aggression or protect against it. Empirical studies have identified several factors that may influence the perpetration of physical aggression and violence (for a review of risk factors, see Farrington et al. 2017; for a review of protective factors, see Lösel and Farrington 2012). First, aspects related to the adolescents’ sociodemographic backgrounds have been considered important risk factors for the perpetration of aggressive acts. For example, violence among adolescents is more prevalent in urban areas with poor living conditions (Derzon 2010), and adolescents from low socioeconomic strata are more likely than other adolescents to have attitudinal dispositions toward aggressive acts as justifiable means for attaining status and goods (Markowitz 2003). Second, personality traits facilitating social competence and mastery have been identified as important for understanding why some individuals choose aggression in situations where other actions might have been possible (Harvey et al. 2001). Third, mental health problems have repeatedly been shown to be related to aggressive behavior (Dutton and Karakanta 2013). This association is probably attributable to the higher prevalence of mood instability and lack of impulse control among people with mental health problems, which in turn may lead to a greater risk of aggressive acts (Dutton and Karakanta 2013). Fourth, substance use and particularly alcohol use have been shown to be risk factors for physical aggression (Tomlinson et al. 2016). The effects of alcohol intoxication, such as disinhibition and impaired judgment in situations where physical aggression is possible, may cause the frequency of alcohol intoxication to be related to such acts (Tomlinson et al. 2016). Fifth, social relationships with parents and peers are important in relation to physical aggression. Proper parental monitoring is found to be a protective factor against aggressive behavior, most likely because parents may influence their offspring’s behavior to a greater degree when they know where their children are and what they are doing (Derzon 2010). Furthermore, empirical studies have shown that being a victim of parental violence is related to the victim’s own future aggressive behavior (Braga et al. 2017). Research on the importance of peers in understanding the perpetration of physical aggression is somewhat mixed, with some studies showing that social interaction with deviant peers is related to increased levels of aggression (Hoeben et al. 2016), whereas other studies emphasize that social isolation from peers in general is a protective factor (Demuth 2004). Finally, being in a romantic relationship has been identified as a risk factor for the perpetration of aggressive acts (Capaldi et al. 2012). Overall, previous studies have identified sociodemographic background, personality characteristics, mental health, substance use, and social relationships as risk factors or protective factors in relation to the perpetration of physical aggression. Hence, time trends in one or several of these factors may explain changes in the prevalence of physical aggression.

Explaining Time Trends in the Perpetration of Physical Aggression

No empirical study offering statistical explanations of time trends in physical aggression has so far been conducted. Thus, we know little about how changes in factors such as sociodemographic background, personality factors, mental health, substance use, and social relationships are related to time trends in the perpetration of physical aggression. However, several studies have identified relevant time trends in various explanatory factors. Concerning sociodemographic background, studies have identified a substantial increase in the proportion of adolescents not living with both biological parents in recent decades (von Soest and Wichstrøm 2014). Studies exploring time trends in personality factors are scarce, although von Soest and Wichstrøm (2014) identified a stable trend in adolescents’ feelings of self-worth from 1992 to 2010. Concerning
mental health problems, several European studies have shown increasing prevalence of internalizing problems among adolescents in the past two decades, especially among girls (Collishaw 2015). Furthermore, studies have shown a marked decrease in alcohol use among adolescents during the same period (Pedersen and von Soest 2015). Finally, some studies have examined time trends in indicators of adolescent social relationships. Collishaw et al. (2012) found an improvement in the quality of parenting from 1986 to 2006, especially regarding parental expectations of youth disclosure and monitoring of adolescents’ leisure time activities. Moreover, long-term studies have shown substantial decreases in the incidence of physical abuse of children by parents since the 1960s (Gilbert et al. 2012), although evidence indicates that the level of abuse has stabilized in recent years (Finkelthor et al. 2014). To sum up, potential declines in the perpetration of physical aggression may be related to declines in alcohol use and a positive trend in parenting, whereas other potential risk and protective factors show time trends that are not in accordance with time trends in aggression (such as mental health) or information on time trends is limited.

**Gender Differences in the Perpetration of Physical Aggression**

Research tends to classify physical aggression as a typically male domain. However, gender differences in aggression are most prominent in the number of arrests for violent crimes and physical fights, while observed differences are smaller for less serious forms of aggressive behavior (Baxendale et al. 2012). Girls’ aggression is more frequently considered to be relational, aiming at dealing with peer or intimate relationships. In contrast, boys’ aggression is more frequently classified as instrumental, where gaining power or influence is of importance (Herrman and Silverstein 2012). Moreover, research has shown substantial gender difference concerning victims of aggressive acts, where girls more often than boys behave aggressively against dating partners (Swahn et al. 2008) and fight with family members (Franke et al. 2002), whereas boys more often use violence against peers (Swahn et al. 2008). To account for this gendered dimension of physical aggression, we examine time trends for boys and girls separately, and distinguish between different acts of physical aggression, as the preponderance of male perpetrators may be stronger in some forms of aggressive behavior than others.

**The Current Study**

This article analyzes data from two repeated cross-sectional studies conducted in 2007 and 2015 among students in the final year of senior high school in Norway. The aim of the study is (1) to investigate whether there have been changes in the prevalence of the perpetration of physical aggression among Norwegian adolescents between 2007 and 2015, and, if so, (2) to examine whether such changes can be explained by changes in potential risk and protective factors during the same period. Furthermore, we explore gender differences in the perpetration of different acts of physical aggression and the victims of such acts. Based on previous research, we expect to find a reduction in physical aggression among Norwegian adolescents. Moreover, we expect this reduction to be at least partially explained by concurrent changes in potential risk and protective factors, especially by a decline in alcohol use. Finally, we hypothesize that measuring different aggressive acts will uncover gendered dimensions of physical aggression, where some acts will be more prevalent among boys while other will be more prevalent among girls.

**Methods**

**Procedure and Participants**

Data from two repeated cross-sectional surveys (“UngVold”) conducted among students in the last year of senior high school in Norway were used (Mossige and Stefansen 2016). The first survey was conducted in 2007 at 67 schools. To obtain a nationally representative sample, Statistics Norway included every school in the country in a pool from which participant schools were selected. The sample was stratified according to geographical region and each school’s sampling probability was proportional to the number of students enrolled in the school, thereby ensuring that the probability of selection was equal for all students in Norway. In 2015, all schools that participated in 2007 were invited to participate in the second survey. Five schools had either closed down or been merged with other schools. Of the remaining 62 schools, 41 agreed to participate. Because the sizes of high schools in Norway had substantially increased from 2007 to 2015, only eight additional schools were invited to participate as replacements to obtain the desired sample size, resulting in a total sample of 49 schools. The replacement schools were selected from the same strata of schools that had either closed down or refused to participate. The surveys were administered over two consecutive school hours, with a teacher present in the room. The schools were instructed to conduct the survey as they would have conducted an examination, to prevent answers to the highly sensitive questions being visible to other students in the class. In 2007, paper and pencil questionnaires were used, whereas the 2015 study was conducted online.
All students at the sample schools were invited to participate in the survey. In 2007, 7033 students participated (response rate 77.3%). In 2015, 4530 students participated (response rate 66.2%). The analyses in this study were restricted to participants 18–20 years of age with a valid answer to the questions about physical aggression and gender. The final sample consisted of 6631 participants in 2007 and 4145 participants in 2015. The analyses showed that the perpetration of physical aggression was not significantly correlated with response rates at the participating schools (2007: \( r = -0.01, p = .50 \); 2015: \( r = .02, p = .18 \)). The samples did not differ significantly in the proportion of girls (2007: 58.8%; 2015: 60.3%; \( \chi^2 = 2.18, p = .14 \)), the proportion of students from immigrant backgrounds (2007: 7.9%; 2015: 8.2%; \( \chi^2 = 0.18, p = .69 \)), or the proportion of students with two parents not working (2007: 6.2%; 2015: 6.9%; \( \chi^2 = 1.83, p = .18 \)). The 2015 participants were slightly older than those in 2007 (2007: \( M = 18.30; 2015: M = 18.37; t = -6.35, p < .001 \)), and the proportion of students with at least one parent with higher education increased slightly (2007: 63.9%; 2015: 65.9%; \( \chi^2 = 4.28, p = .04 \)).

**Measures**

**Physical aggression**

Physical aggression was measured by the perpetration of three different aggressive acts during the last 12 months ("clawed or pulled the hair on someone," "slapped someone," "hit or kicked someone"), with response options no, yes, and an open field for number of occasions in 2007, and fixed response options no, yes, once, and yes, more than once in 2015. All three items were dichotomized into no instances of the measured aggressive act vs. at least one instance of the measured act during the last 12 months. Moreover, for some analyses, all three items were combined into an instrument measuring the perpetration of at least one of the aggressive acts vs. no acts of aggression during the last 12 months. Those who answered in the affirmative to at least one of the three questions were asked to provide information about the victim(s) of the aggressive act, with response options "acquainted adolescent," "unknown adolescent," "girlfriend/boyfriend," "sibling," "parent," and "other adult."

**Sociodemographic background**

Two questions on sociodemographic background were included in the analyses: having two parents currently not working and not living with both biological parents.

**Personality factors**

Personality factors were measured by three subscales from the Resilience Scale for Adolescents (READ; Hjemdal et al. 2006): "Personal Competence" (five items; \( \alpha = .71 \)), "Social Competence" (four items; \( \alpha = .77 \)), and "Structured Style" (three items; \( \alpha = .70 \)). The subscales measure individual dispositional attributes of resilience in difficult life situations. More specifically, Personal Competence measures an individual’s level of self-esteem, self-efficacy, and a realistic orientation to life (e.g., "I know how to reach my goals," "I feel competent," and "when things go badly I have a tendency to find something good that can come out of it"). Social Competence measures attributes related to extraversion, social adeptness, good communication skills, and flexibility in social matters (e.g., "I easily find new friends," "I always find something fun to talk about," and "I always find something comforting to say to others when they are sad"). Structured Style measures preference for planning and structure in daily life (e.g., "I always make a plan before I start something new" and "I am good at organizing my time") (Hjemdal et al. 2006). The students were asked to evaluate their feelings about themselves and people around them during the past month, and response options ranged from 1 (totally agree) to 5 (totally disagree). Previous research from both Norway (von Soest et al. 2010) and Ireland (Kelly et al. 2017) has shown that the instrument has acceptable internal consistency and satisfactory convergent validity as it is correlated with expected social and life outcomes.

**Mental health problems**

Mental health problems were measured by an eight-item version of the Hopkins Symptom Checklist (HSCL; Derogatis et al. 1974), with responses to items concerning mental health problems in the previous week on a scale ranging from 1 (not at all distressed) to 4 (very much distressed). The students were asked about how often they had been "bothered or troubled" by the following states: "suddenly scared for no reason," "feeling fearful," "nervousness or shakiness inside," "feeling too tired to do things," "feeling blue," "feeling hopeless about the future," "feeling tense or keyed up," and "worrying too much about things." Internal consistency was high (\( \alpha = .89 \)), and previous studies have shown that shorter versions of the HSCL perform almost as well as the full version (Strand et al. 2003).

**Substance use**

Alcohol intoxication was measured by a question on frequency of intoxication in the previous 12 months, with response options of never (0), 1–4 times (1), 5–10 times (2),
Social resources were measured by one more subscale from READ, "Social Resources" (five items; \(\alpha = .81\)), developed for measuring perceived availability of social support from friends and relatives (e.g., "my friends always stick together," "I have some close friends/family members that really care about me," and "I always have someone that can help me when I need it"). The students were asked to evaluate their feelings the last month, with response options from 1 (totally agree) to 5 (totally disagree). The parent–child relationship was measured by two subscales of a short version of the Parental Bonding Instrument (Parker et al. 1979). The students were asked to evaluate how they perceived their parents while growing up. The "Overprotection" subscale (six items, \(\alpha = .74\)) measured parental control and overprotection vs. encouragement of independence, including items such as "they liked me to make my own decisions," "they tried to control everything I did," and "they tended to baby me." The "Care" subscale (five items, \(\alpha = .77\)) measured parental care and involvement vs. indifference and rejection (e.g., "they appeared to understand my problems and worries," "they were affectionate to me," and "they did not help me as much as I needed"). The response options ranged from 1 (corresponds very well) to 4 (corresponds very poorly). Previous research has identified satisfactory psychometric properties (Klimidis et al. 1992a) and convergent validity (Klimidis et al. 1992b) of short forms of the Parental Bonding Instrument. A single item measured whether an adult family member had ever hit the respondent. Finally, peer relationships were measured by two dichotomous items: whether the respondents had ever had a girlfriend/boyfriend and whether they had any close friends.

### Statistical Analyses

To identify evidence of time trends in physical aggression, the extent to which the prevalence of aggressive acts and victims of such acts differed between 2007 to 2015 were analyzed by means of logistic regression analyses. Next, analyses were performed to identify potential explanatory factors of time trends in aggressive behavior. To serve as a factor that can account for time trends, explanatory variables need to fulfill three criteria: (1) evidence of time trends corresponding to those trends identified for aggression, (2) a correlation with aggression, and (3) a reduction in time trends in aggression when adjusting for the explanatory variable (von Soest and Wichstrøm 2014). A series of logistic and linear regression analyses were therefore performed to examine time trends in potential risk and protective factors. Second, all potential explanatory factors were correlated with physical aggression. Third, potential explanatory variables were entered one by one in multiple logistic regression analyses together with a dummy variable for survey year to predict physical aggression. These analyses provided the possibility to examine whether the inclusion of potential explanatory variables reduced the time trend in physical aggression. Moreover, we conducted mediation analyses to test whether the association between survey year and physical aggression was statistically significantly reduced when entering potential explanatory variables in the regression model. More specifically, mediation effects were estimated by the product of coefficients approach in a path analytic framework (Hayes 2009). As recommended in the literature (Hayes 2009), we estimated bias corrected standard errors of the mediation effects by means of bootstrapping based on 5000 bootstrap samples.

Additional analyses were conducted to examine whether associations between potential explanatory variables and physical aggression were moderated by gender. Such moderator effects would indicate that the strength of the association changed from 2007 to 2015, and would open for the possibility that changes in aggression from 2007 and 2015 could be a result of changes in the association between risk or protective factors and aggression, and not change in the level of such potential factors. For this purpose, logistic regression analyses were conducted where survey year, potential explanatory variables, and the interaction term of those variables were included as predictors of physical aggression. Similarly, interaction analyses were conducted to examine whether the associations between survey year and potential explanatory factors for physical aggression were moderated by gender. Such moderation effects would indicate a need to conduct separate analyses for boys and girls.

Collinearity analyses were conducted, providing variance inflation factors ranging from 1.01 to 1.49. The statistical program Mplus 8 was used for all analyses. Full information maximum likelihood estimation procedures were used, thereby providing contemporary missing data routines that are considered to be adequate (Schafer and Graham 2002).
All analyses were additionally conducted using listwise deletion, yielding similar results.

**Results**

The prevalence of perpetrated physical aggression significantly declined between 2007 and 2015, for all aggressive acts and for both boys and girls (see Table 1). Among boys, the prevalence of scratching or pulling the hair on someone declined from 4.2 to 1.8% between the two surveys, slapping from 11.1 to 6.5%, and hitting or kicking from 17.4 to 9.9%. The total prevalence of physical aggression, as assessed by having exercised at least one of the three forms of aggression, declined from 22.6 to 12.8%. Logistic regression analyses showed no significant interactions between gender and survey year (scratched or pulled the hair on someone: \( p = .18 \); slapped someone: \( p = .80 \); hit or kicked someone: \( p = .63 \); any physical aggression: \( p = .35 \)), thereby indicating no significant differences in time trends in aggression between boys and girls.

Table 1 further shows that among boys, the most common victims of adolescent physical aggression at both time points were adolescent acquaintances, with 54.6% of the perpetrators reporting such victims in 2007 and 56.9% in 2015. More than 40% of the male perpetrators at both time points reported aggression against unknown adolescents, while 15% reported use of physical aggression against siblings. Few boys reported aggression against girlfriends/boyfriends, parents, or other adults.

Among female perpetrators, the most commonly reported victims were adolescent acquaintances, with 43.6% of victimization in 2007 and 49.5% in 2015. Unlike boys, the second most common type of victim among girls were girlfriends/boyfriends and siblings; 20 to 32% of perpetrators reported such victims. The proportion of girls who reported using physical aggression against siblings decreased significantly between 2007 and 2015. Aggressive acts against unknown adolescents were uncommon among girls, with a victimization rate of 16.3% in 2007 and a significant decline to 8.7% in 2015. Few girls reported use of physical aggression against parents and other adults.

The first step in identifying potential explanatory factors for the observed time trends in aggression was to examine whether any of the factors showed trends in accordance with physical aggression. Table 2 shows analyses of time trends in potential risk and protective factors for aggressive acts. The proportion of boys not living with both biological parents increased significantly between 2007 and 2015.
Furthermore, boys reported a small but significant increase in the personality factors of Personal Competence and Structured Style, as well as in mental health problems. The incidence of alcohol intoxication and alcohol-related problems decreased significantly, while the use of illicit drugs increased. The boys reported a small but significant decrease in Social Resources, while changes in parenting styles were not significant. Finally, a significantly lower proportion of the boys had been victims of violence from a family member, fewer had ever had a girlfriend/boyfriend, and fewer boys had any close friends. The girls showed no change in sociodemographic factors between 2007 and 2015. A small decline in Social Competence was the only significant change in personality factors. As among boys, the incidence of mental health problems among girls increased. Moreover, a similar decline in problematic alcohol use was observed, but the use of illicit drugs did not increase among the girls. Concerning social relationships, girls reported a significant decline in Social Resources, having overprotective parents, and ever having had a girlfriend/boyfriend, while more girls reported not having any close friends. In summary, alcohol intoxication, frequency of alcohol-related problems, family violence, having had a girlfriend/boyfriend, and having no close friends showed time trends consistent with the perpetration of physical aggression for both genders, while Personal Competence and Structured Style were particularly relevant for boys, and overprotective parenting for girls.

The second step in identifying explanatory factors for time trends in aggression was examining associations between such factors and aggression. For this purpose, we first examined by means of interaction analyses whether the relationship between potential explanatory variables and aggression differed across survey year. The logistic regression analyses showed only one significant interaction effect among all 15 potential explanatory factors (p < .05), a result that may be due to chance because of multiple testing. The analyses thus indicated similar associations between potential risk and protective factors and physical aggression in 2007 and 2015. Therefore, correlations between explanatory factors and aggression were estimated for the combined data from 2007 and 2015 (see Table 3). In general, the correlations between the different aggressive acts and potential explanatory factors were quite similar, which in combination with the similarity in time trends for the different acts justifies using a combined instrument of the three items in the analyses explaining time trends in aggression.

Use of alcohol or illicit drugs and being the victim of violence from a family member correlated strongest with physical aggression (r = .11–.34), and most correlations had what is considered to be small to medium effect sizes (Cohen 1988). Interaction analyses by means of logistic regression analyses showed significant gender differences in the associations of Personal Competence, Social Competence, alcohol intoxication, use of illicit drugs, and Social Resources with aggression (p < .05), thereby warranting

### Table 2 Changes in potential risk and protective factors for physical aggression 2007–2015 for boys and girls

<table>
<thead>
<tr>
<th></th>
<th>Boys M (SD) or %</th>
<th></th>
<th></th>
<th>Girls M (SD) or %</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2007 (n = 2730)</td>
<td>2015 (n = 1647)</td>
<td>p</td>
<td>2007 (n = 3901)</td>
<td>2015 (n = 2498)</td>
<td>p</td>
</tr>
<tr>
<td>Both parents not working (%)</td>
<td>5.2</td>
<td>6.2</td>
<td>.193</td>
<td>6.9</td>
<td>7.3</td>
<td>.495</td>
</tr>
<tr>
<td>Not living with both biological parents (%)</td>
<td>26.3</td>
<td>29.9</td>
<td>.013</td>
<td>28.8</td>
<td>30.6</td>
<td>.130</td>
</tr>
<tr>
<td>READ personal competence (1–5)</td>
<td>3.79 (0.72)</td>
<td>3.87 (0.78)</td>
<td>.002</td>
<td>3.49 (0.75)</td>
<td>3.49 (0.80)</td>
<td>.963</td>
</tr>
<tr>
<td>READ social competence (1–5)</td>
<td>4.06 (0.74)</td>
<td>4.01 (0.83)</td>
<td>.065</td>
<td>4.00 (0.72)</td>
<td>3.90 (0.77)</td>
<td>.001</td>
</tr>
<tr>
<td>READ structured style (1–5)</td>
<td>3.43 (0.86)</td>
<td>3.58 (0.89)</td>
<td>&lt;.001</td>
<td>3.54 (0.82)</td>
<td>3.54 (0.88)</td>
<td>.745</td>
</tr>
<tr>
<td>Mental health problems (1–4)</td>
<td>1.46 (0.51)</td>
<td>1.52 (0.57)</td>
<td>&lt;.001</td>
<td>1.81 (0.64)</td>
<td>2.01 (0.74)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Alcohol intoxication (1–6)</td>
<td>3.30 (1.23)</td>
<td>2.91 (1.26)</td>
<td>&lt;.001</td>
<td>3.27 (1.19)</td>
<td>2.81 (1.21)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Number of alcohol-related problems (0–50)</td>
<td>5.73 (7.48)</td>
<td>4.44 (5.94)</td>
<td>&lt;.001</td>
<td>5.29 (6.36)</td>
<td>3.95 (5.00)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Use of illicit drugs (%)</td>
<td>14.3</td>
<td>18.7</td>
<td>&lt;.001</td>
<td>10.5</td>
<td>10.8</td>
<td>.760</td>
</tr>
<tr>
<td>READ social resources (1–5)</td>
<td>4.45 (0.61)</td>
<td>4.37 (0.71)</td>
<td>.001</td>
<td>4.51 (0.59)</td>
<td>4.39 (0.69)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Parenting style-care (0–3)</td>
<td>2.35 (0.50)</td>
<td>2.38 (0.52)</td>
<td>.055</td>
<td>2.42 (0.53)</td>
<td>2.43 (0.55)</td>
<td>.763</td>
</tr>
<tr>
<td>Parenting style-overprotection (0–3)</td>
<td>0.94 (0.53)</td>
<td>0.92 (0.53)</td>
<td>.196</td>
<td>0.93 (0.54)</td>
<td>0.87 (0.53)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Family violence (%)</td>
<td>13.3</td>
<td>8.5</td>
<td>&lt;.001</td>
<td>20.0</td>
<td>9.6</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Ever had a girlfriend/boyfriend (%)</td>
<td>75.8</td>
<td>67.0</td>
<td>&lt;.001</td>
<td>80.7</td>
<td>65.7</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>No close friends (%)</td>
<td>2.3</td>
<td>4.2</td>
<td>&lt;.001</td>
<td>1.4</td>
<td>3.5</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>
Table 3 Correlation matrix between all study variables. Boys above the diagonal, girls below the diagonal.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>11</th>
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<th>14</th>
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<th>16</th>
<th>17</th>
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<th>19</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Any physical aggression</td>
<td>65**</td>
<td>-0.10</td>
<td>-0.04</td>
<td>0.11</td>
<td>0.06</td>
<td>0.04</td>
<td>0.00</td>
<td>-0.06</td>
<td>0.01</td>
<td>-0.09</td>
<td>0.00</td>
<td>-0.04</td>
<td>-0.06</td>
<td>0.00</td>
<td>0.02</td>
<td>0.02</td>
<td>0.05</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>2. Scratched or punched the hair on someone</td>
<td>-0.10</td>
<td>62**</td>
<td>-0.08</td>
<td>0.08</td>
<td>0.04</td>
<td>0.03</td>
<td>0.00</td>
<td>-0.06</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.02</td>
<td>0.00</td>
<td>0.00</td>
<td>0.02</td>
<td>0.05</td>
</tr>
<tr>
<td>3. Slapped someone</td>
<td>-0.04</td>
<td>-0.08</td>
<td>67**</td>
<td>-0.09</td>
<td>0.05</td>
<td>0.04</td>
<td>0.00</td>
<td>-0.06</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.02</td>
<td>0.00</td>
<td>0.00</td>
<td>0.02</td>
<td>0.05</td>
</tr>
<tr>
<td>4. Hit or kicked someone</td>
<td>0.11</td>
<td>0.08</td>
<td>-0.09</td>
<td>67**</td>
<td>0.05</td>
<td>0.04</td>
<td>0.00</td>
<td>-0.06</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.02</td>
<td>0.00</td>
<td>0.00</td>
<td>0.02</td>
<td>0.05</td>
</tr>
<tr>
<td>5. Not living with both biological parents</td>
<td>0.06</td>
<td>0.04</td>
<td>0.05</td>
<td>0.04</td>
<td>67**</td>
<td>0.03</td>
<td>0.00</td>
<td>-0.06</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.02</td>
<td>0.00</td>
<td>0.00</td>
<td>0.02</td>
<td>0.05</td>
</tr>
<tr>
<td>6. Not having Personal Competence</td>
<td>0.04</td>
<td>0.03</td>
<td>0.04</td>
<td>0.03</td>
<td>0.03</td>
<td>67**</td>
<td>0.01</td>
<td>-0.06</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.02</td>
<td>0.00</td>
<td>0.00</td>
<td>0.02</td>
<td>0.05</td>
</tr>
<tr>
<td>7. Not having Social Resources</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.01</td>
<td>0.01</td>
<td>67**</td>
<td>-0.06</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.02</td>
<td>0.00</td>
<td>0.00</td>
<td>0.02</td>
<td>0.05</td>
</tr>
<tr>
<td>8. Not having any close friends</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>67**</td>
<td>-0.06</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.02</td>
<td>0.00</td>
<td>0.00</td>
<td>0.02</td>
<td>0.05</td>
</tr>
<tr>
<td>9. No close friends</td>
<td>-0.09</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.06</td>
<td>67**</td>
<td>-0.06</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.02</td>
<td>0.00</td>
<td>0.00</td>
<td>0.02</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Further analyses to be conducted separately for boys and girls. Not living with both biological parents, Personal Competence, Social Resources, and not having any close friends were uncorrelated with physical aggression among boys, while having two parents not working and not having any close friends were uncorrelated with aggression among girls. Therefore, these factors cannot explain the observed decline in the perpetration of physical aggression.

Finally, logistic regression analyses were conducted to examine the role of potential risk and protective factors for time trends in physical aggression (see Table 4). According to the analyses showing similar time trends and correlations for the individual aggressive acts, further analyses were conducted on the combined instrument measuring the perpetration of any acts of physical aggression. Separate logistic regression analyses were also conducted for each of the individual aggressive acts, yielding similar results (analyses not shown). In a first model, survey year was included as the sole predictor of physical aggression (Table 4, Baseline Model). In accordance with the figures from Table 1, the odds ratio (OR) of 0.50 for boys indicated that the odds of reporting perpetration of physical aggression was reduced by 50% in 2015 compared with 2007. In Model 1, potential risk and protective factors were included one by one in addition to survey year to predict aggressive acts among boys. The results presented in Table 4 show that all the included factors except Personal Competence were significantly related to the perpetration of physical aggression. Moreover, mediation analyses showed that Structured Style, frequency of alcohol intoxication, number of alcohol-related problems, family violence, and having had a girlfriend/boyfriend were significant mediators of the association between survey year and aggression, indicating that the inclusion of these factors reduced the difference in physical aggression between 2007 and 2015. The inclusion of mental health problems and use of illicit drugs resulted in a decreased OR for survey year, while the rest of the included factors had minor influence. In Model 2, all the factors that were significantly related to the perpetration of physical aggression and had similar developmental trends were included simultaneously, resulting in a change in the OR for survey year from 0.50 to 0.61. The change indicated a weaker, but still significant, relationship between aggressive behavior and time, given the inclusion of the potential risk and protective factors. Among the factors included in the multivariate analysis, all factors except Structured Style remained significantly related to the perpetration of physical aggression and significantly contributed to mediating the relationship between survey year and aggression. The total mediating effect of all included factors was $b = -0.24$ ($p < .001, 95\% CI [-0.30, -0.18]$).

The regression analyses among girls showed similar results to those of boys (see Table 5). The OR for survey year
The change in aggression from 2007 to 2015 is estimated by the **OR** of the association between survey year and aggression. **Indirect effect (mediation effect) of the association between survey year and aggression via potential explanatory variables.** Indirect effects provide as much information about whether included explanatory variables statistically reduce the estimate of change in aggression from 2007 to 2015

<table>
<thead>
<tr>
<th>Relationship of potential explanatory variable with aggression</th>
<th>Indirect effect</th>
<th>Change in aggression from 2007 to 2015$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OR</strong></td>
<td><strong>95% CI</strong></td>
<td><strong>b</strong></td>
</tr>
<tr>
<td>Baseline model</td>
<td>Without predictors</td>
<td>0.50***</td>
</tr>
<tr>
<td>Model 1 (separate analyses for each predictor)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both parents not working</td>
<td>1.41**</td>
<td>[1.01, 1.85]</td>
</tr>
<tr>
<td>Not living with both biological parents</td>
<td>1.20*</td>
<td>[1.01, 1.42]</td>
</tr>
<tr>
<td>READ personal competence (1–5)</td>
<td>0.92</td>
<td>[0.83, 1.03]</td>
</tr>
<tr>
<td>READ social competence (1–5)</td>
<td>1.13*</td>
<td>[1.01, 1.26]</td>
</tr>
<tr>
<td>READ structured style (1–5)</td>
<td>0.85***</td>
<td>[0.78, 0.93]</td>
</tr>
<tr>
<td>Mental health problems (1–4)</td>
<td>1.52***</td>
<td>[1.33, 1.72]</td>
</tr>
<tr>
<td>Alcohol intoxication (1–6)</td>
<td>1.61***</td>
<td>[1.49, 1.74]</td>
</tr>
<tr>
<td>Number of alcohol-related problems (0–50)</td>
<td>1.11***</td>
<td>[1.09, 1.12]</td>
</tr>
<tr>
<td>Use of illicit drugs</td>
<td>3.45***</td>
<td>[2.87, 4.14]</td>
</tr>
<tr>
<td>READ social resources (1–5)</td>
<td>0.89</td>
<td>[0.79, 0.99]</td>
</tr>
<tr>
<td>Parenting style-care (0–3)</td>
<td>0.65***</td>
<td>[0.56, 0.75]</td>
</tr>
<tr>
<td>Parenting style-overprotection (0–3)</td>
<td>1.34***</td>
<td>[1.15, 1.54]</td>
</tr>
<tr>
<td>Family violence</td>
<td>2.31***</td>
<td>[1.87, 2.85]</td>
</tr>
<tr>
<td>Ever had a girlfriend/boyfriend</td>
<td>1.69***</td>
<td>[1.39, 2.04]</td>
</tr>
<tr>
<td>No close friends</td>
<td>1.65*</td>
<td>[1.07, 2.44]</td>
</tr>
<tr>
<td>Model 2 (all variables with trends in accordance to physical aggression included simultaneously)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structured style (1–5)</td>
<td>0.91</td>
<td>[0.82–1.00]</td>
</tr>
<tr>
<td>Alcohol intoxication (0–6)</td>
<td>1.17**</td>
<td>[1.07–1.28]</td>
</tr>
<tr>
<td>Number of alcohol-related problems (0–50)</td>
<td>1.09***</td>
<td>[1.07–1.11]</td>
</tr>
<tr>
<td>Family violence</td>
<td>2.32***</td>
<td>[1.84–2.89]</td>
</tr>
<tr>
<td>Ever had a girlfriend/boyfriend</td>
<td>1.25*</td>
<td>[1.03–1.55]</td>
</tr>
</tbody>
</table>

**OR** odds ratio, **b** unstandardized indirect effect, **95% CI** 95% confidence interval

$^a$ Indirect effect (mediation effect) of the association between survey year and aggression via potential explanatory variables. Indirect effects provide as much information about whether included explanatory variables statistically reduce the estimate of change in aggression from 2007 to 2015

$^b$ The change in aggression from 2007 to 2015 is estimated by the **OR** of the association between survey year and aggression

*p < .05, **p < .01, ***p < .001

year in the Baseline Model was 0.45. In Model 1, all factors except having two parents not working and having no close friends were significantly related to the perpetration of physical aggression. Including alcohol use, overprotective parenting, family violence, and having had a girlfriend/boyfriend in the analyses resulted in significant mediation effects on the **OR** for survey year, while the inclusion of Structured Style, mental health problems, and Social Resources resulted in a decrease in the **OR**. The remaining factors had minor influence on the **OR** for survey year. In Model 2, frequency of alcohol intoxication, number of alcohol-related problems, family violence, overprotective parenting style, and having had a girlfriend/boyfriend were included. The **OR** for survey year changed from 0.45 to 0.57, and mediation analyses showed a significant change in the relationship between survey year and the perpetration of physical aggression. However, the relationship was still significant. Of the variables included in the multivariate analyses, alcohol-related problems, overprotective parenting, family violence, and having had a boyfriend/girlfriend were related to higher levels of physical aggression, and all the variables significantly mediated the relationship between survey year and aggression. The total mediating effect of the included factors in the model was $b = −0.25 (p < .001, 95% CI [−0.30, −0.20]). Alcohol intoxication was significantly related to physical aggression, but did not function as a significant mediator of the association between survey year and aggression in the multiple model.
The change in aggression from 2007 to 2015 is estimated by the indirect effect (mediation effect) of the association between survey year and aggression via potential explanatory variables. Indirect effects provide as such information about whether included explanatory variables statistically reduce the estimate of change in aggression from 2007 to 2015.

Table 5 Logistic regression analyses with the perpetration of physical aggression as dependent variable and year of survey and potential risk and protective factors as independent variables (girls)

| Relationship of potential explanatory variable with aggression | Indirect effect | Change in aggression from 2007 to 2015
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR 95% CI</td>
<td>b 95% CI OR 95% CI</td>
</tr>
<tr>
<td>Baseline model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without predictors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 1 (separate analyses for each predictor)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both parents not working</td>
<td>1.22 [0.96, 1.54]</td>
<td>0.00 [0.00, 0.01]</td>
</tr>
<tr>
<td>Not living with both biological parents</td>
<td>1.42*** [1.24, 1.63]</td>
<td>0.01 [0.00, 0.02]</td>
</tr>
<tr>
<td>READ personal competence (1–5)</td>
<td>0.74*** [0.68, 0.80]</td>
<td>0.00 [–0.01, 0.01]</td>
</tr>
<tr>
<td>READ social competence (1–5)</td>
<td>0.85*** [0.78, 0.93]</td>
<td>0.02** [0.01, 0.03]</td>
</tr>
<tr>
<td>READ structured style (1–5)</td>
<td>0.75*** [0.69, 0.80]</td>
<td>0.00 [–0.01, 0.02]</td>
</tr>
<tr>
<td>Mental health problems (1–4)</td>
<td>1.60*** [1.46, 1.75]</td>
<td>0.10*** [0.07, 0.12]</td>
</tr>
<tr>
<td>Alcohol intoxication (1–6)</td>
<td>1.34*** [1.27, 1.42]</td>
<td>–0.14*** [–0.17, –0.11]</td>
</tr>
<tr>
<td>Number of alcohol-related problems (0–50)</td>
<td>1.09*** [1.08, 1.10]</td>
<td>–0.12*** [–0.14, –0.09]</td>
</tr>
<tr>
<td>Use of illicit drugs</td>
<td>2.16*** [1.81, 2.59]</td>
<td>0.00 [–0.01, 0.01]</td>
</tr>
<tr>
<td>READ social resources (1–5)</td>
<td>0.73*** [0.66, 0.80]</td>
<td>0.04*** [0.02, 0.05]</td>
</tr>
<tr>
<td>Parenting style-care (0–3)</td>
<td>0.64*** [0.57, 0.71]</td>
<td>0.00 [–0.01, 0.01]</td>
</tr>
<tr>
<td>Parenting style-overprotection (0–3)</td>
<td>1.55*** [1.38, 1.74]</td>
<td>–0.02*** [–0.04, –0.01]</td>
</tr>
<tr>
<td>Family violence</td>
<td>2.21*** [1.88, 2.56]</td>
<td>–0.08*** [–0.11, –0.06]</td>
</tr>
<tr>
<td>Ever had a girlfriend/boyfriend</td>
<td>1.60*** [1.35, 1.88]</td>
<td>–0.07*** [–0.10, –0.05]</td>
</tr>
<tr>
<td>No close friends</td>
<td>1.02 [0.63, 1.56]</td>
<td>0.00 [–0.01, 0.01]</td>
</tr>
<tr>
<td>Model 2 (all variables with trends in accordance to physical aggression included simultaneously)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol intoxication (0–6)</td>
<td>1.07 [0.99–1.15]</td>
<td>–0.03 [–0.06, 0.00]</td>
</tr>
<tr>
<td>Number of alcohol-related problems (0–50)</td>
<td>1.08*** [1.06–1.09]</td>
<td>–0.10*** [–0.13, –0.08]</td>
</tr>
<tr>
<td>Parenting style-overprotection (0–3)</td>
<td>1.30*** [1.14–1.47]</td>
<td>–0.01** [–0.03, –0.01]</td>
</tr>
<tr>
<td>Family violence</td>
<td>1.92*** [1.62–2.27]</td>
<td>–0.07*** [–0.09, –0.05]</td>
</tr>
<tr>
<td>Ever had a girlfriend/boyfriend</td>
<td>1.32** [1.11–1.56]</td>
<td>–0.04** [–0.07, –0.02]</td>
</tr>
</tbody>
</table>

OR odds ratio, b unstandardized indirect effect, 95% CI 95% confidence interval

a Indirect effect (mediation effect) of the association between survey year and aggression via potential explanatory variables. Indirect effects provide as such information about whether included explanatory variables statistically reduce the estimate of change in aggression from 2007 to 2015

b The change in aggression from 2007 to 2015 is estimated by the OR of the association between survey year and aggression

*p < .05, **p < .01, ***p < .001

Discussion

Although previous research has identified declining levels of physical aggression among adolescents in many parts of the world (Pickett et al. 2013), empirical studies examining potential explanations for such time trends are scarce. This study contributes to filling this knowledge gap by investigating the importance of concurrent time trends in potential risk and protective factors for understanding trends in aggressive behavior. The results in this article showed a considerable decline in the perpetration of physical aggression among Norwegian adolescents from 2007 to 2015. The most common victims of adolescent aggressive acts for both genders were adolescent acquaintances. Boys further reported frequent use of aggression against unknown adolescents, whereas girls more frequently reported aggressive acts against romantic partners and siblings. The most prominent explanatory factors for the decline in aggression were an observed decline in the frequency of alcohol intoxication and the number of alcohol-related problems, particularly among boys. Furthermore, declines in reported family violence and the proportion of participants ever having had a girlfriend/boyfriend were related to a reduction in physical aggression. Factors related to sociodemographic background, personality characteristics, and mental health problems did not contribute to explaining the time trends in the perpetration of physical aggression; nor did the use of illicit drugs or most factors related to social relationships.
The observed developmental trend in physical aggression is consistent with a US study by Finkelhor et al. (2014), who reported a 46% decline in hitting, slapping, or pushing other children among 6–17-year-olds from 2003 to 2011, with a 26% decline in just three years from 2008 to 2011. However, other studies measuring physical fighting found less extensive declines in this type of aggressive behavior in both US samples (Kann et al. 2016) and cross-national studies (Pickett et al. 2013). Thus, the results indicate a considerable reduction in a broad range of aggressive behaviors such as clawing, pulling hair, slapping, hitting, kicking, and pushing, whereas the reduction may be more moderate in some specific forms of aggression, such as physical fighting. The present study indicates that examining a variety of forms of aggressive acts is important to obtain detailed information about time trends in aggression among adolescents.

The nature of the assessment of physical aggression may also be important with regard to gender differences. As in studies of physical fighting (Pickett et al. 2013), the present study found a substantially higher prevalence of hitting and kicking among boys than among girls. However, clawing, pulling hair, and slapping were more frequently reported by girls than boys in both 2007 and 2015. The results accord with the notion of a gendered pattern of aggressive behavior, where more serious physical aggression is a typically male domain, whereas girls are socialized into learning that such actions are unfeminine and inappropriate for girls (Baxendale et al. 2012). Instead, girls may participate in other forms of aggressive behavior, such as relational and indirect aggression (Herrman and Silverstein 2012), as well as in physical aggression that fits into a stereotypical female gender role, such as clawing and pulling hair. The higher proportion of aggressive acts from girls directed against romantic partners and siblings may also indicate that girls express relational aggression to a greater degree than boys. Thus, physical aggression may not only be a male phenomenon, but the nature, severity, and choice of victim may differ between boys and girls.

The most prominent explanatory factor for the decline in physical aggression was problematic alcohol use, measured by the frequency of alcohol intoxication and number of alcohol-related problems experienced during the previous year. The substantial decline in alcohol use in this study is consistent with trends observed in previous reports from both Norway (Pedersen and von Soest 2015) and Denmark (Andersen et al. 2014), especially those concerning problematic use of alcohol (Pedersen and von Soest 2015). Given the well-established relationship between alcohol use and aggression (Tomlinson et al. 2016), it is not surprising that problematic alcohol use stands out as an important explanation for declining levels of physical aggression among adolescents. First, a decline in the frequency of alcoholic intoxication may lead to fewer situations in which adolescents show aggressive behavior because of the negative effects of alcohol on inhibition and decision-making. Second, adolescents typically consume alcohol in crowded places among unknown and intoxicated peers, which may increase the risk of aggression. Nonetheless, this study is the first to provide statistical indications for the role of alcohol use in explaining time trends in the perpetration of physical aggression.

Another explanatory factor was experiences with violence in the family. In contrast to research showing rather stable levels of physical abuse from parents in the past two decades (Gilbert et al. 2012), the present study showed a substantial decline in the proportion of adolescents reporting being hit by a family member. Nevertheless, previous studies have shown a relationship between exposure to abuse at a young age and adolescents’ own aggressive behavior (Braga et al. 2017), which is typically explained by social learning of aggression as being an appropriate action in various situations (Braga et al. 2017). As with alcohol use, the observed decline in the incidence of being hit by a family member, which is an established risk factor for a person’s own aggressive behavior, may be a viable explanation for some of the reduction in physical aggression.

Finally, a decline in the proportion of adolescents reporting having ever had a girlfriend/boyfriend explained some of the reduction in the perpetration of physical aggression. Likewise, a reduction in the proportion of girls with overprotective parents explained some of the reduction in aggressive acts, but the effects were small. The results indicate that social and relational factors may be important for explaining time trends in physical aggression, particularly among girls.

Several of the variables did not contribute to explaining the time trends in physical aggression. Mental health problems and use of illicit drugs showed opposite time trends as the perpetration of physical aggression. Furthermore, including mental health problems in the analyses significantly strengthened the relationship between physical aggression and survey year for both genders, as did use of illicit drugs among boys. This finding indicates that the included factors, instead of providing a statistical explanation for the relationship between aggression and time, actually suppressed time trends in aggression. The results thus indicate that levels of physical aggression could have been even lower if mental health problems (and illicit drug use among boys) had not increased from 2007 to 2015. Thus, even though mental health problems and use of illicit drugs did not explain the time trends in aggressive behavior in this study, reductions in mental health problems and illicit drug use among adolescents may still be related to reductions in the perpetration of aggressive acts.
analyses showed few or no significant changes in socio-demographic factors, personality factors, and most measures of social relationships among Norwegian adolescents, making the measures included in this study unsuitable explanations of changes in physical aggression.

The explanatory factors in this study only partially explain the observed relationship between the perpetration of physical aggression and survey year, indicating that other unobserved factors are important for explaining changes in aggression over time. It has been supposed that declining levels of problem behaviors among adolescents may be caused by adolescents now spending less time outdoors or in the company of other adolescents than previously (Finkelhor et al., 2014), but no empirical research has yet examined this potential explanation. New technology and social media have provided the adolescents of today with new ways of communicating and making arrangements, so that adolescents simply do not “hang out” to the same degree as they used to do. This new form of interaction among adolescents may reduce the number of encounters where many forms of problem behavior are likely to occur, for example, situations where adolescents meet and grow bored outside of adult control (Hoeben et al., 2016). Examining changes in communication and interaction patterns between adolescents, and how such changes influence the prevalence of aggression and other forms of problem behavior, are an important future research focus.

Using data from large-scale, nationally representative samples of Norwegian adolescents at two time points with identical recruitment procedures is a major strength, but the study also has limitations. First, the causal direction of the relationship between the perpetration of aggression and the potential risk or protective factors could not be definitely established because of the cross-sectional nature of the surveys at both time points. The issue of reverse causal directions may be of particular importance for potential risk factors such as harsh parenting, where aggressive behavior among adolescents may influence parental behavior toward offspring. A second limitation is that the present study is based on data from only two time points. More time points would allow more detailed descriptions of time trends. A third limitation is the lower response rate in 2015 compared with 2007. Even though analyses of the response rates at the participating schools showed no significant relationship between physical aggression and response rates, it is possible that the observed decline in aggressive acts is partly a result of selection bias because of the diminishing response rates. Fourth, the change from paper to online questionnaires may also have an implication for the results, even though previous studies have shown that switching from paper to online questionnaires does not affect data content or data quality (Denscombe, 2006). Fifth, using a sample of students in the last year of high school may influence the estimated level of physical aggression. It is likely that the incidence of problem behavior is lower in the participating samples than in the general adolescent population, because of the selection of adolescents who attend the final year of high school in Norway. Finally, a limitation is the possibility that adolescents may have changed their view and conception of aggressive acts and that aggression may be conceived as more socially undesirable in 2015 than 2007. This may lead to an increased rate of underreporting of aggressive acts.

Conclusions

The present study is the first to examine how time trends in physical aggression among adolescents may be statistically explained by concurrent trends in a variety of potential risk and protective factors. Moreover, the study provides new knowledge about gender differences in aggressive behavior. The study showed an about 50% reduction in the self-reported perpetration of physical aggression among Norwegian adolescents in just eight years. Further, boys more frequently reported using physical aggression against acquaintances or unknown adolescents, while girls more frequently reported aggression towards adolescent acquaintances, romantic partners, or siblings. Most important, the study provides new knowledge for understanding time trends in physical aggression among adolescents. The findings indicate that reducing the level of alcohol use among adolescents may be important for reducing the general level of physical aggression in this age group. The analyses also show that the level of exposure to violence in the family is related to a decline in adolescents’ own aggressive behavior. Nonetheless, other unidentified causes contributed to some of the reduction in the perpetration of physical aggression, warranting further research on the topic of time trends in aggressive behavior. Of special interest is the influence of contemporary changes in adolescents’ communication and social lives on the prevalence of both aggressive behavior and other forms of problem behavior.

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Authors’ Contributions

L.R.F. conceived the study, participated in its design and coordination, performed the statistical analyses, and drafted the manuscript. T.v.S. participated in design and interpretation of the statistical analyses and helped to draft the manuscript. All authors read and approved the final manuscript.

Data Sharing Declaration

The data that support the findings of this study are available from Norwegian Social Research (NOVA) but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available.
Funding The research was supported by grants from the Norwegian Ministry of Justice and Public Security.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no competing interests.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. All ethical aspects of the study were approved by the Regional Committees for Medical and Health Research Ethics and the Norwegian Centre for Research Data.

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Physical Fighting and Leisure Activities among Norwegian Adolescents—Investigating Co-occurring Changes from 2015 to 2018

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Abstract
After many years of decline in violent behavior among adolescents in several Western countries, recent official statistics indicate a possible trend change. So far, knowledge on how this change is related to co-occurring changes in leisure time activities is limited. Using two cross-sectional surveys from Oslo, Norway, this study found substantial increases in the prevalence of physical fighting from 2015 ($N = 23,381$; 51.6% girls) to 2018 ($N = 25,287$; 50.8% girls) in junior and senior high school. The rise in fighting was related to co-occurring changes in several leisure activities, including increasing time spent unsupervised by adults, rising digital media use, and rising cannabis use. The study emphasizes the importance of considering leisure time activities when addressing adolescent misbehavior.

Keywords Time trends · Physical fighting · Violence · Leisure activities

Introduction
Research has found declining levels of violent behavior among adolescents in the last two decades (Arnett 2018). In the last few years, however, a possible trend change has been unveiled. Crime statistics show an increase in violent crime among young people in Norway (The City of Oslo and Oslo Police District 2019) and a rise of crime in general among young men in Sweden (The Swedish National Council for Crime Prevention 2020). In Denmark, the level of registered violent crime in the population is at its highest level since 1995 (Statistics Denmark 2020). Increasing our knowledge of factors related to changes in the prevalence of violence on the societal level is important in view of developing prevention strategies. Co-occurring changes in leisure time activities have been hypothesized to be important for understanding changes in the societal level of adolescent violence (Arnett 2018). However, a lack of suitable data has so far hampered statistical investigations of the observed changes (for exceptions, see Frøyland and von Soest 2018; Salas-Wright et al. 2017). The present study utilized the population-based high school surveys Young in Oslo 2015 and Young in Oslo 2018 to investigate changes in physical fighting on the societal level among Norwegian adolescents over a three-year span. Co-occurring changes in a variety of adolescent leisure time activities were investigated as potential contribution factors for the shifting violence rates, among them leisure time both supervised and unsupervised by adults, the use of digital media, and substance use.

Time Trends in Violent Behavior
In many Western countries, research has identified declining levels of violent behavior among adolescents in past decades. For example, the cross-national survey Health Behaviour in School-Aged Children (HBSC) found a marked decline in physical fighting between 2002 and 2010 among 11- to 15-year olds in 19 of 30 participating countries in Europe and North America, whereas stable trends were found in eight countries, and only three showed an increase (Pickett et al. 2013). The results have been corroborated by studies conducted in the period from 1991 to
2017 in Norway (Frøyland and von Soest 2018), Sweden (Svensson and Ring 2007), and the United States (Centers for Disease Control and Prevention 2018). Alongside the observed decline in violent behavior, other forms of problem behavior among adolescents show similar trends (Arnett 2018).

However, a possible trend change has occurred since 2014–2015, and the police in several countries have issued warnings about increasing levels of violent behavior among both adolescents and in the general population. After a steady decline from 2007 to 2013 in police registered violent crime among adolescents under the age of 18 in Oslo, the capital of Norway, the number of violent crimes increased from 259 to 499 from 2013 to 2018, an increase of 93% in five years (The City of Oslo and Oslo Police District 2019). Danish crime statistics also show a marked increase in violent crime in the general population from 2015 to 2019 (Statistics Denmark 2020), while Swedish crime statistics show a 20% increase in the number of registered suspects of crime among boys in the age group 18–20 years from 2015 to 2019 (The Swedish National Council for Crime Prevention 2020). The police in England and Wales reported a 7% increase in recorded offences involving a knife or sharp instrument from 2018 to 2019, a finding that was co-occurring with a 2% increase in hospitalizations due to injuries related to the use of sharp objects. The prevalence of less serious forms of violent crime was rather stable (Office for National Statistics 2020).

So far, self-report studies on the possible trend changes in violent behavior are scarce. However, the U.S. Youth Risk Behavior Survey (YRBS), which has revealed a steady decline in physical fighting among high school students for over 10 years, showed a small (but statistically non-significant) increase in such behavior from 2015 to 2017 (Centers for Disease Control and Prevention 2018). In total, these figures signal a possible shift in the unitary trend of a decreasing level of violent behavior among adolescents in past decades, although future research has to provide more information about whether reports of increasing prevalence of violent behavior are stable and long-lasting.

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Leisure Activities and Violent Behavior

One of the most prominent theoretical frameworks for understanding crime rate trends is the Routine Activity Approach (Hollis et al. 2013), which hypothesize that one key element for crime to be likely to occur in a given time and space is the absence of capable guardians, such as the absence of adults in the vicinity when adolescents behave aggressively, combined with the presence of a likely offender and a suitable target. This study addresses the key role of adult supervision in theoretical models of understanding crime rate trends by examining how changes in leisure time patterns are related to adolescent physical fighting, because leisure time activities arguably are the most important domain in adolescents’ life where adult supervision is changing.

In line with theoretical approaches, researchers have shown that time spent unsupervised by adults (Hoebe et al. 2016) and low parental knowledge of adolescents’ activities (Flanders et al. 2019) are important individual level risk factors for adolescent crime. Unstructured leisure time spent with peers without an authority figure present has also been related to individual offending, through placing adolescents in a situation with a lack of adult social control and no presence of capable guardians (Haynie and Osgood 2005).

Adult supervision during adolescent leisure time has seen marked changes in recent years. Whereas spending time out with friends without adult supervision was an important part of being young 20 years ago, U.S. adolescents now spend significantly more of their leisure time at home, an arena where adults most often are present (Twenge 2017). Organized leisure activities are another arena for spending leisure time under adult supervision, but research on trends in adolescent participation in organized activities is scarce. However, a recent study found no change in adolescent participation in school-based extracurricular activities the last three decades (Meier et al. 2018), which is in line with findings from older studies on general participation in organized leisure activities (Mahoney et al. 2006).

An issue related to the time adolescents spend under adult supervision is their use of digital media. One line of reasoning is that rising media use among adolescents have led to a decline in unstructured socializing, which again has contributed to a decline in problem behavior (Arnett 2018). Whereas adolescents 50 years ago rarely spent time in this manner, screen time is the most prominent leisure time activity among young people today (Twenge et al. 2018). By staying at home in front of a screen, today’s adolescents spend more time in the vicinity of adults and are exposed to fewer situations that facilitate norm-breaking behavior. However, researchers have suggested that increased portability of digital media platforms will over time erode the gains achieved regarding trends in adolescent problem behavior (Green 2016).

New patterns of digital media use among adolescents may also increase the risk of problematic behavior. Research has shown that some adolescents use social media to communicate threats, taunts, and intimidations, which in turn is related to real-life violent and criminal behavior (Cannon et al. 2015). The combination of such patterns of use and the fact that social media are increasingly used on smartphones outside the home (Pew Research Center 2018) may render an association between increases in social media use and rising levels of violence possible. No studies have so far investigated the association between trends in social
media use and trends in violence, but a recent review identified a positive cross-sectional association between social media use and adolescent aggression (Vannucci et al. 2020).

Finally, co-occurring changes in substance use may be relevant for understanding changes in the rate of adolescent violence on a societal level. Although perhaps not a leisure activity in itself, substance use is a recreational activity among adolescents that can be directly related to the individual propensity of aggressive and violent behavior (Tomlinson et al. 2016) and normally happens without adult presence. Especially important are the intoxicating effects of alcohol, which may result in impaired judgment in situations where violent behavior is a possible action (Tomlinson et al. 2016). Cannabis use is also associated with violent behavior (Liu and Petras 2017), but the association is typically explained as an indirect association caused by an antisocial lifestyle in general or by other confounding variables (Barthelemy et al. 2016). Alcohol use has declined significantly among adolescents in the last two decades (Pape et al. 2018), and previous research has identified a significant association between co-occurring declines in aggressive behavior and alcohol intoxication among Norwegian adolescents (Frøyland and von Soest 2018). A study among US adolescents also included trends in five measures on substance use as control variables for understanding a decline in physical fighting, but the analyses did not single out the effects of substance use from effects of other control variables included in the study (Salas-Wright et al. 2017). Hence, investigation of whether an increase in fighting at the societal level also co-occurs with shifting trends in substance use is warranted.

**Key Background Variables**

When analyzing associations between changes in physical fighting and co-occurring changes in leisure time activities, it is of importance to account for simultaneous changes in key background variables that may be underlying drivers of the observed associations. In particular, changes in the share of adolescents with migration background and differences across time in socioeconomic background, academic achievements, and age of participants may account for the observed changes in both physical fighting (Salas-Wright et al. 2017) and patterns of leisure time activities (Bartko and Eccles 2003). These key background variables were, therefore, included as control variables in all analyses.

**Current Study**

This study investigates changes in the rate of physical fighting between 2015 and 2018 among adolescents in Oslo, Norway, and how potential shifts are related to co-occurring changes in leisure time activities. Three aspects of adolescent leisure time were considered: adult supervision, digital media use, and substance use. Based on recent data from official crime statistics, an increase in physical fighting among adolescents in Oslo from 2015 to 2018 was anticipated. The increase was expected to be related to a range of potential changes in adolescents’ leisure time activities without adult supervision, among them an increase in time spent out with friends, a decrease in time spent at home, less parental knowledge of adolescent activities, and a decline in participation in organized leisure activities. Further, co-occurring changes in digital media use were hypothesized to be related to the anticipated rise in physical fighting. Even though increasing time in front of a screen in older studies is related to trends towards more adult supervision and less violence, the present study might not necessarily show such a relationship because associations of screen use with adult supervision and being at home may have changed in recent years due to the extensive use of smartphones. Finally, increases in alcohol intoxication and cannabis use, if observed, were hypothesized to be related to the expected increase in adolescent physical fighting. Changes in physical fighting may as well be related to potential changes in key background variables, such as years of schooling, socioeconomic background, migration background, and school grades. These background variables were therefore included as control variables in all analyses.

**Methods**

**Procedure and Participants**

The present study used data from two school-based cross-sectional surveys of adolescents in Oslo, Norway in 2015 and 2018 (Young in Oslo 2015 and Young in Oslo 2018). All junior and senior high schools in Oslo were asked to participate in the surveys. Except for schools for students with special needs or difficulties with the Norwegian language and a few private senior high schools, all Oslo schools accepted the invitation. Students at the participating junior or senior high schools were invited to complete an electronic questionnaire in class, containing questions about their social lives, health, leisure activities, drug use, and misbehavior. In the 2015 survey, 23,381 students participated, yielding a response rate of 79%. The response rates at junior and senior high schools were 86% and 72%, respectively. In 2018, 25,287 students participated, with an overall response rate of 74%. Response rates were 83% and 65% at junior and senior high schools, respectively. As the surveys sampled almost a complete population of students attending high school in Oslo, only adolescents that did not
attend high school or were absent from school at the time of the survey did not receive an invitation to participate. In total, approximately two out of three adolescents in the age group 13–18 residing in Oslo participated in the surveys. Students consented to participation by filling out the survey; the parents of students younger than age 18 were given the option to decline their children’s participation. The Norwegian Center for Research Data approved all ethical aspects of the senior high school survey, and the survey was conducted anonymously for the students at junior high schools.

**Measures**

**Physical fighting**

Physical fighting was assessed in 2015 by two items from an instrument measuring the frequency of different conduct problems: “How many times have you done any of the following things over the past year (the past 12 months)?” with the items “have been in a fight (without weapons)” and “have been in a fight where you used a weapon (e.g., a knife)” In the 2018 survey, one item assessed participation in physical fighting: “have been in a fight.” At both time points, response options were never (0), once (1), 2–5 times (2), 6–10 times (3), and 11 times or more (4). To generate comparable variables for the two time points, a single variable was computed for 2015, retaining the maximum score for the two items measuring physical fighting. For all regression analyses, physical fighting was dichotomized at both time points into no fights versus at least one fight. All other study measures were assessed identically in the two surveys.

**Adult supervision**

Five instruments assessed activities and situations with varying degree of adult supervision. First, parental supervision (Oliveus 1989) was measured using three items on parents’ knowledge of their children’s social life: “My parents usually know where I am, and who I’m with, in my free time,” “My parents know most of the friends I hang out with in my free time,” and “My parents know my friends’ parents.” The response options were not true at all (1), not very true (2), quite true (3), and very true (4). Mean scores were computed, ranging from 1 to 4 ($\alpha = 0.74$). Second, a mean score was generated by averaging six items measuring participation in the following organized leisure activities in the previous month: “sports club,” “youth club,” “religious organization,” “band, choir, orchestra,” “cultural school/music school,” and “other organization, team, association.” The response options were never (0), 1–2 times (1), 3–4 times (2), and 5 times or more (3), returning a variable with a range from 0 to 3. Third, to assess the amount of time spent at home, the respondents’ indicated in a single item how many times in the previous week they had “been at home the whole evening,” with response options never (0), once (1), 2–5 times (2), and 6–10 times (3), and 11 times or more (4).

**Digital media use**

A single item was used to assess how much time the respondents normally used outside of school on “activities in front of a screen (TV, computer, tablet, smartphone),” with response options no time (0), less than 1 h (1), 1–2 h (2), 2–3 h (3), 3–4 h (4), 4–6 h (5), and more than 6 h (6). A second single item assessed how much time the respondents spent daily on “social media (e.g., Facebook, Instagram, etc.),” with response options no time (0), under 30 min (1), 30 min to 1 h (2), 1–2 h (3), 2–3 h (4), and more than 3 h (5).

**Substance use**

Alcohol intoxication and cannabis use were assessed by two single items from an instrument measuring the frequency of alcohol intoxication and illicit drug use in the previous 12 months, with response options never (0), once (1), 2–5 times (2), 6–10 times (3), and 11 times or more (4).

**Years of schooling**

A single item measured the respondents’ years of schooling (range 8–13).

**Socioeconomic background**

The respondents’ socioeconomic background was measured by a composite score, averaging the score of three variables ranging from 0 to 3: (a) the number of parents having a university degree, (b) the number of books in the home of the respondents, and (c) the average score on the four-item Family Affluence Scale II (Currie et al. 2008). The instrument has been presented in detail in previous publications (Pedersen et al. 2018).

**Migration background**

Migration background was assessed using a single item separating those with two parents born outside of Norway from the remaining participants.
School grades

School grades in the subjects written Norwegian, English, and mathematics were assessed, and a mean score was computed (range 1–6).

Gender

The participants’ gender was assessed.

Statistical Analyses

Changes in the prevalence of physical fighting from 2015 to 2018 were analyzed by means of cross tabulations and χ² tests. Next, several analyses were conducted to investigate whether co-occurring changes in leisure time activities contributed to statistically account for the change in physical fighting. To be able to account for changes in physical fighting, the included variables had to fulfill three criteria: (1) changes had to correspond to changes in physical fighting, (2) the variable had to correlate with physical fighting, and (3) the variable had to show a significant indirect effect in mediation analyses (Fristyland and von Soest 2018). To account for the possibility of gender-specific associations between physical fighting and the different leisure time activities, moderation analyses included a dummy variable for survey year, each of the leisure time activities, gender, and interaction terms between gender and the leisure time activities were conducted. The identification of significant interactions would imply a need for conducting gender separated analyses. Second, a series of linear regression analyses identified changes over time in the included leisure time activities. Third, all variables were correlated with physical fighting. Fourth, all leisure time activities that correlated with physical fighting and showed appropriate co-occurring changes were included one by one in separate probit regression analyses, together with a dummy variable for survey year. Whether the change in the leisure activity was significantly related to the change in physical fighting was assessed by means of mediation analyses under the counterfactual framework (VanderWeele 2015), which is the recommended framework for conducting mediation analyses with binary outcomes. Potential outcome probabilities were calculated based on the parameter estimates from the probit analyses, and results were presented as risk differences of these probabilities for the total effect (TE), the natural direct effect (NDE), and the natural indirect effect (NIE). The TE shows the increase in risk for physical fighting between the counterfactual outcomes of letting the total sample be from 2018 and allowing the mediator to change to the value from 2018 compared to letting the total sample be from 2015 and keeping the mediator value to the level from 2015. The NDE shows the increase in risk for physical fighting between the counterfactual outcomes of letting the total sample be from 2018, but keeping the mediator as it was in 2015, compared to letting the total sample be from 2015 and keeping the mediator as it was in 2015. The NIE shows the increase in risk for physical fighting between the counterfactual outcomes of letting the total sample be from 2018 and allowing the mediator to change to the value from 2018 compared to letting the total sample be from 2018 and keeping the mediator value to the level from 2015. Standard errors were estimated using the Delta method. The Delta method generally returns valid estimates in large samples (Muthén et al. 2016). Finally, all leisure time variables with a significant NIE in the bivariate analyses were included in multivariate analyses where the combined NIE of change in all the leisure time variables was calculated. The analyses were conducted based on recommended methods for analyzing the combined impact of multiple mediators on a binary outcome using structural equation models (Nguyen et al. 2016). To account for possible confounding, years of schooling, socioeconomic background, migration background, and school grades were included as control variables in all analyses. Mediation analyses were additionally conducted using the product-of-coefficients method (Hayes 2018), tables are included in the appendices.

The analyses were conducted using Mplus Version 8.3. Missing data were handled by the full information maximum likelihood procedure, thereby providing missing data routines that are considered to be state of the art (Schafer and Graham 2002). All analyses were also conducted using listwise deletion, yielding similar results. Due to the large sample size, only findings with p-values less than 0.01 were considered statistically significant.

Results

The prevalence of physical fighting among Oslo adolescents increased significantly from 2015 to 2018 (see Table 1). In junior high school, the prevalence rates for boys increased from 31.4% in 2015 to 38.1% in 2018 and from 8.9% to 13.1% for girls. The rate of physical fighting was somewhat lower among students in senior high school at both time points. Among senior high school boys, 20.4% reported physical fighting in the previous 12 months in 2015, while 29.4% had participated in a fight in 2018. The prevalence rates for senior high school girls increased from 5.8% in 2015 to 8.5% in 2018. At both time points and in both junior and senior high school, about 50% of the boys who reported physical fighting had participated in one fight and 50% in more than one fight. Among girls, participation in only one fight in the previous 12 months was more common than participating in more than one fight. In general, the prevalence rates increased for all response options, indicating that both the proportion of adolescents participating in physical fighting
and the frequency of such behavior increased. The prevalence rates were significantly higher for boys than for girls. Concerning the changes from 2015 to 2018 in the instrument measuring physical fighting, all but 7 of the respondents in 2015 that reported physical fighting with a weapon also reported fighting without a weapon, indicating that the two versions of the instrument to a large degree capture a corresponding group of respondents in the two surveys.

Initial moderation analyses revealed that the associations between physical fighting and eight out of the nine explanatory variables varied by gender ($p < 0.01$), thereby indicating a need for gender-specific analyses. The school levels were combined in the remaining analyses, with years of schooling, socioeconomic background, migration background, and school grades included as control variables. The surveys were conducted 3 years apart, and there is a substantial overlap of the samples as many of the junior high school participants in the first survey are attending senior high school in the second survey. Accordingly, all analyses were also conducted separately for junior and senior high school, returning similar results.

The proportion of girls did not differ between the two surveys (2015: 51.6%; 2018: 50.8%; $\chi^2 = 2.835$, $p = 0.092$). Table 2 shows additional descriptive statistics for all study variables for boys and girls in both surveys. The proportion of students with a migration background did not change neither for boys nor girls between the two surveys. The average years of schooling was slightly higher in 2015 than in 2018, while the average socioeconomic background and school grades increased slightly from 2015 to 2018.

The first step in identifying factors potentially relevant for understanding the increase in physical fighting was to analyze co-occurring changes in relevant leisure time activities; Table 2 shows the results. Factors related to an increased risk of physical fighting on an individual level in previous research should show co-occurring changes in the same direction as fighting, while factors related to a lessened risk should show opposing changes. Concerning adult supervision, the level of parental knowledge of adolescent activities and participation in organized activities increased among both boys and girls, making changes in these domains unsuitable for understanding the observed increase in physical fighting. On the other hand, the amount of time spent at home decreased for both genders, and a change in this manner of spending leisure time could be related to an increase in fighting. Turning to activities typically unsupervised by adults, both boys and girls reported spending more leisure time out with friends, highlighting this variable as potentially relevant for understanding the increase in physical fighting. Similarly, school truancy increased among boys, but it remained stable among girls. As expected, both screen time in general and the use of social media increased for both genders and were as such included in further analyses. Finally, the prevalence of alcohol intoxication remained unchanged among both boys and girls, but both genders reported a significant increase in their use of cannabis. A co-occurring change in cannabis use could therefore be relevant for understanding the increase in physical fighting. Summing up, co-occurring changes in evenings at home, evenings out with friends, screen time, social media use, and cannabis use remained potentially relevant for understanding the increase in physical fighting for both genders, while school truancy was relevant for boys only.

The second step in identifying factors potentially relevant for understanding the increase in fighting was to examine correlations between the included variables (see Table 3). As expected, factors that on an individual level are considered to decrease the risk of violence were negatively correlated with physical fighting, and factors considered to increase the risk correlated in the opposite direction. For boys, the highest correlations were observed for school truancy, cannabis use, and evenings out with friends ($r = 0.20–0.28$), whereas for girls, school truancy, cannabis use, and parental supervision correlated the highest with physical fighting ($r = 0.13–0.23$). Most correlations were in the range of small to medium effects according to the classification by Cohen (1988).

In a final step of analysis, all factors correlated with physical fighting and showing co-occurring changes in the appropriate direction were included in separate probit regression analyses

| Table 1 Frequency of physical fighting in 2015 and 2018 in boys and girls in junior high school and senior high school |
|--------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Boys                                             | Girls  |
| Junior high school                               | Senior high school |
| %        | %      | %        | %      | %        | %      | %        | %      | %        | %      | %        | %      | %        | %      | %        | %      |
| No physical fighting                             | 68.6   | 3,853    | 61.9   | 4,110    | 79.6   | 3,929    | 70.6   | 3,516    | 91.1   | 5,428    | 86.9   | 5,972    | 94.2   | 5,142    | 91.5   | 5,034    |
| Once                                             | 15.9   | 894      | 18.0   | 1,197    | 10.4   | 515      | 14.2   | 709      | 5.4    | 321      | 7.7    | 529      | 3.9    | 211      | 5.4    | 299      |
| 2–5 times                                        | 10.9   | 611      | 13.7   | 910      | 7.4    | 364      | 10.1   | 504      | 2.7    | 162      | 3.6    | 250      | 1.4    | 79       | 2.1    | 116      |
| 6–10 times                                       | 2.1    | 118      | 2.4    | 162      | 1.4    | 68       | 1.9    | 97       | 0.4    | 25       | 0.8    | 53       | 0.2    | 12       | 0.4    | 20       |
| 11 times or more                                 | 2.6    | 144      | 3.9    | 262      | 1.2    | 61       | 3.1    | 156      | 0.4    | 23       | 1.0    | 72       | 0.2    | 12       | 0.5    | 30       |
| Total                                            | 100.0  | 5,620    | 100.0  | 6,641    | 100.0  | 4,937    | 100.0  | 4,982    | 100.0  | 5,959    | 100.0  | 6,876    | 100.0  | 5,456    | 100.0  | 5,499    |

Note. All differences over time, gender, and school level were significant at $p < 0.001$.
Table 2 Descriptive statistics and change in study variables 2015–2018

| Leisure time activities | Total | M (SD) | M (SD) | C. s | dp 2015 | C. s | dp 2018 | C. s | dp 2018 | M (SD) | M (SD) | C. s | dp 2015 | C. s | dp 2018 |
|-------------------------|-------|--------|--------|------|--------|------|--------|------|--------|--------|--------|------|------|--------|------|--------|
| Parental monitoring (1–4) | 3.11 (0.60) | 3.13 (0.69) | 0.08 | 0.18 | 3.21 (0.80) | 3.27 (0.63) | 0.07 | 0.138 | 3.23 (0.60) | 3.27 (0.61) | 0.07 | 0.364 | 3.18 (0.63) | 3.20 (0.66) | 0.04 |
| Activity at home (0–3) | 1.79 (0.88) | 1.84 (0.84) | 0.06 | 0.06 | 1.88 (0.84) | 1.89 (0.84) | 0.04 | -0.001 | 1.93 (0.83) | 1.96 (0.83) | 0.03 | 0.066 | 1.84 (0.84) | 1.89 (0.84) | 0.05 |
| Organized leisure activities (0–3) | 0.35 (0.20) | 0.35 (0.20) | 0.00 | <0.001 | 0.35 (0.20) | 0.35 (0.20) | 0.00 | <0.001 | 0.35 (0.20) | 0.35 (0.20) | 0.00 | <0.001 | 0.35 (0.20) | 0.35 (0.20) | 0.00 |
| Leisure time with friends (0–3) | 1.66 (0.65) | 1.73 (0.67) | 0.06 | 0.06 | 1.76 (0.68) | 1.73 (0.67) | 0.06 | 0.009 | 1.80 (0.67) | 1.77 (0.67) | 0.03 | 0.040 | 1.73 (0.67) | 1.72 (0.66) | 0.01 |
| Screen time | 3.97 (0.89) | 3.97 (0.89) | 0.00 | <0.001 | 3.97 (0.89) | 3.97 (0.89) | 0.00 | <0.001 | 3.97 (0.89) | 3.97 (0.89) | 0.00 | <0.001 | 3.97 (0.89) | 3.97 (0.89) | 0.00 |
| Social media use (0–3) | 0.13 (0.41) | 0.13 (0.41) | 0.00 | <0.001 | 0.13 (0.41) | 0.13 (0.41) | 0.00 | <0.001 | 0.13 (0.41) | 0.13 (0.41) | 0.00 | <0.001 | 0.13 (0.41) | 0.13 (0.41) | 0.00 |
| Alcohol intoxication (0–4) | 0.72 (1.17) | 0.80 (1.21) | 0.07 | <0.001 | 0.74 (1.15) | 0.73 (1.21) | 0.01 | <0.001 | 0.73 (1.16) | 0.76 (1.17) | 0.03 | <0.001 | 0.81 (1.37) | 0.81 (1.37) | 0.00 |
| School truancy (0–6) | 3.52 (1.46) | 3.86 (1.39) | 0.24 | <0.001 | 3.34 (1.42) | 3.67 (1.34) | 0.24 | <0.001 | 3.42 (1.45) | 3.76 (1.37) | 0.24 | <0.001 | 0.81 (1.37) | 0.81 (1.37) | 0.00 |

Note: Difference tests for the leisure time activities were conducted by linear regression analyses with years of schooling, socioeconomic background, migration background, and school grades as control variables.
Table 3 Correlation matrix between all study variables: boys above the diagonal, girls below the diagonal

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Physical fighting (0–4)</td>
<td>–</td>
<td>–0.13**</td>
<td>–0.08**</td>
<td>0.12**</td>
<td>0.20**</td>
<td>0.28**</td>
<td>0.03**</td>
<td>0.14**</td>
<td>0.12**</td>
<td>0.21**</td>
</tr>
<tr>
<td>2. Parental monitoring (1–4)</td>
<td>–0.13**</td>
<td>–</td>
<td>0.00</td>
<td>0.13**</td>
<td>–0.05**</td>
<td>–0.23**</td>
<td>–0.11**</td>
<td>–0.09**</td>
<td>–0.17**</td>
<td>–0.20**</td>
</tr>
<tr>
<td>3. Evenings at home (0–3)</td>
<td>–0.02*</td>
<td>–0.01</td>
<td>–</td>
<td>–0.07**</td>
<td>–0.21**</td>
<td>–0.04**</td>
<td>0.21**</td>
<td>–0.07**</td>
<td>–0.09**</td>
<td>–0.07**</td>
</tr>
<tr>
<td>4. Organized leisure activities (0–3)</td>
<td>0.03**</td>
<td>0.11**</td>
<td>–0.07**</td>
<td>–</td>
<td>0.09**</td>
<td>–0.04**</td>
<td>–0.14**</td>
<td>0.04**</td>
<td>–0.10**</td>
<td>–0.06**</td>
</tr>
<tr>
<td>5. Evenings out with friends (0–3)</td>
<td>0.10**</td>
<td>–0.09**</td>
<td>–0.22**</td>
<td>0.01</td>
<td>–</td>
<td>0.19**</td>
<td>–0.04**</td>
<td>0.24**</td>
<td>0.28**</td>
<td>0.22**</td>
</tr>
<tr>
<td>6. School truancy (0–4)</td>
<td>0.23**</td>
<td>–0.29**</td>
<td>–0.04**</td>
<td>–0.12**</td>
<td>0.22**</td>
<td>–</td>
<td>0.14**</td>
<td>0.19**</td>
<td>0.37**</td>
<td>0.39**</td>
</tr>
<tr>
<td>7. Screen time (0–6)</td>
<td>0.10**</td>
<td>–0.13**</td>
<td>0.13**</td>
<td>–0.10**</td>
<td>0.09**</td>
<td>0.20**</td>
<td>–</td>
<td>0.26**</td>
<td>0.06**</td>
<td>0.08**</td>
</tr>
<tr>
<td>8. Social media use (0–5)</td>
<td>0.10**</td>
<td>–0.08**</td>
<td>–0.01</td>
<td>–0.07**</td>
<td>0.22**</td>
<td>0.20**</td>
<td>0.50**</td>
<td>–</td>
<td>0.19**</td>
<td>0.15**</td>
</tr>
<tr>
<td>9. Alcohol intoxication (0–4)</td>
<td>0.04**</td>
<td>–0.22**</td>
<td>–0.12**</td>
<td>–0.14**</td>
<td>0.29**</td>
<td>0.39**</td>
<td>0.08**</td>
<td>0.16**</td>
<td>–</td>
<td>0.58**</td>
</tr>
<tr>
<td>10. Cannabis use (0–4)</td>
<td>0.19**</td>
<td>–0.21**</td>
<td>–0.07**</td>
<td>–0.08**</td>
<td>0.17**</td>
<td>0.36**</td>
<td>0.08**</td>
<td>0.10**</td>
<td>0.46**</td>
<td>–</td>
</tr>
</tbody>
</table>

*p < 0.01; **p < 0.001

Table 4 Results of probit regression analyses with physical fighting as dependent variable and year of survey and leisure time activities as predictors

<table>
<thead>
<tr>
<th>Boys</th>
<th>Total effect (TE)*b</th>
<th>Natural direct effect (NDE)b</th>
<th>Natural indirect effect (NIE)b</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RD</td>
<td>99% CI</td>
<td>RD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evenings at home (0–3)</td>
<td>8.4%</td>
<td>[6.8, 10.0%]</td>
<td>8.6%</td>
</tr>
<tr>
<td>Evenings out with friends (0–3)</td>
<td>8.4%</td>
<td>[6.8, 10.0%]</td>
<td>7.8%</td>
</tr>
<tr>
<td>School truancy (0–4)</td>
<td>8.1%</td>
<td>[6.5, 9.7%]</td>
<td>6.7%</td>
</tr>
<tr>
<td>Screen time (0–6)</td>
<td>8.4%</td>
<td>[6.8, 10.0%]</td>
<td>8.0%</td>
</tr>
<tr>
<td>Social media use (0–5)</td>
<td>8.4%</td>
<td>[6.8, 10.0%]</td>
<td>7.1%</td>
</tr>
<tr>
<td>Cannabis use (0–4)</td>
<td>8.2%</td>
<td>[6.6, 9.7%]</td>
<td>6.2%</td>
</tr>
<tr>
<td>Girls</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evenings at home (0–3)</td>
<td>3.8%</td>
<td>[2.9, 4.6%]</td>
<td>3.8%</td>
</tr>
<tr>
<td>Evenings out with friends (0–3)</td>
<td>3.7%</td>
<td>[2.9, 4.6%]</td>
<td>3.5%</td>
</tr>
<tr>
<td>Screen time (0–6)</td>
<td>3.8%</td>
<td>[2.9, 4.6%]</td>
<td>3.2%</td>
</tr>
<tr>
<td>Social media use (0–5)</td>
<td>3.8%</td>
<td>[3.0, 4.7%]</td>
<td>3.2%</td>
</tr>
<tr>
<td>Cannabis use (0–4)</td>
<td>3.6%</td>
<td>[2.8, 4.4%]</td>
<td>3.2%</td>
</tr>
</tbody>
</table>

Note. Years of schooling (centered), socioeconomic background (centered), migration background, and school grades (centered) were included as control variables in all analyses. Probabilities were calculated at the value 0 for all control variables. RD: risk difference; 99% CI: 99% confidence interval of RD

*TE shows the increase in risk for physical fighting between the counterfactual outcomes of letting the total sample be from 2015 and keeping the mediator value to the level from 2015

*NDE shows the increase in risk for physical fighting between the counterfactual outcomes of letting the total sample be from 2018, but keeping the mediator as it was in 2015, compared to letting the total sample be from 2015 and keeping the mediator as it was in 2015

*NIE shows the increase in risk for physical fighting between the counterfactual outcomes of letting the total sample be from 2018 and allowing the mediator to change to the value from 2018 compared to letting the total sample be from 2018 and keeping the mediator value to the level from 2015

digital media use, and cannabis use for both genders, as well as an increase in school truancy for boys. The amount of time spent at home decreased for both genders, but it was not related to the changes in physical fighting. Parental supervision and participation in organized leisure activities changed in the opposite direction of physical fighting, and the level of alcohol intoxication was stable in boys and declined in girls. As such, these factors were not of relevance for understanding the observed increase in physical fighting.

The increase in physical fighting among Oslo youth co-occurs with a not able increase in registered youth crime in the same area. According to police statistics (The City of Oslo and Oslo Police District 2019), the level of violent crime among adolescents under the age of 18 has not been higher on this side of the millennium than it was in 2018. The increase in violent crime in Oslo is more pronounced than what is found in other countries, but it is partly corroborated by recent increases in registered crime among young boys in Sweden (The Swedish National Council for Crime Prevention 2020) and violent crime in Denmark (Statistics Denmark 2020) and knife-related violence in the UK (Office for National
Statistics 2020) in the general population. Even though crime statistics in several countries indicate a possible trend change in recent years, it is premature to conclude whether the observed increase in adolescent violence is part of a permanent trend of a higher level of adolescent misbehavior or just represents short-lasting fluctuations.

The present study hypothesized that three different domains related to adolescent leisure time are important for understanding changes in violent behavior: adult supervision, digital media use, and substance use. A notable finding is that the increase in physical fighting indeed co-occurred with an increase in time spent on activities normally happening outside of adult control, as measured by time spent out with friends and school truancy. This finding supports the notion that leisure time unsupervised by adults can be important for understanding changes in the rate of adolescent misbehavior on a societal level. Of note, study results are in line with theories such as the Routine Activity Approach, where a key component for understanding the occurrence of crime is a lack of capable guardians (Hollis et al. 2013). Similarly, others have suggested that increased socialization with delinquent peers may be a central aspect for understanding adolescent problem behavior (Hoeben et al. 2016). Previous research found that the amount of time that adolescents spend hanging out with friends has decreased significantly in the last two decades (Twenge 2017), which has been hypothesized as a contributing cause of the observed decline in problem behavior (Arnett 2018). Therefore, the fact that trend changes in spending leisure time out with friends co-occurs with increased rates of violent behavior is especially interesting. However, results also showed an increase in time spent participating in organized activities, which are typically under adult supervision. The increase in physical fighting might have been even larger if time spent in this manner had decreased as well.

Regarding digital media use, increases in overall screen time and in time spent on social media were related to the increase in physical fighting for both genders. This partly contradicts previous research suggesting that an increase in screen time contributes to a decline in problem behavior among adolescents (Arnett 2018). However, the pacifying effect of digital media is expected to disappear because digital media platforms become increasingly portable (Green 2016). Studies have also suggested that specific aspects of social media use, such as bullying and aggressive communication, can increase the risk of real-life violent behavior (Cannon et al. 2015). The co-occurring increases in physical fighting and both overall screen time and social media use may therefore be a result of the role of smartphones in modern media consumption, which enable adolescents to use digital media, and especially social media, outside of the home (Pew Research Center 2018). Following this, social media can be used in a context that facilitates physical fighting, such as in unsupervised communication with peer groups.

Finally, an increase in the use of cannabis remained one of the most prominent changes related to the increase in physical fighting. It is probable that an increased frequency of cannabis use may be related to an increasing number of adolescents socializing with delinquent peers (Haynie and Osgood 2005). In other words, the increase in cannabis use may be associated to the increase in fighting through processes where adolescents more often are socializing in environments that facilitate delinquent behaviors such as both cannabis use and physical fighting. This interpretation is in line with previous studies indicating that the association between cannabis use and violence is mainly a result of an antisocial lifestyle in general (Barthelemy et al. 2016).

The present study utilized two high-quality surveys covering about two out of three adolescents between the ages of 13 and 18 residing in the municipality of Oslo, Norway, thereby providing a solid base for examining co-occurring associations between adolescent leisure time activities and violent behavior. The close proximity in time of the surveys also facilitated an analysis of how fast-changing trends in digital media use were associated with adolescent physical fighting. Although co-occurring changes in the leisure time activities included in this study statistically could account for over 35% of the observed increase in physical fighting among boys and over 30% among girls, a sizeable portion of the increase in fighting was not accounted for by the included factors. A possible factor for understanding changes in the societal level of adolescent violence not explored in the present study is mental health problems, which have been found to be related to violent behavior (Dutton and Karakanta 2013) and have also increased among adolescents in recent years (Collishaw 2015). The acceptance of violent behavior may also vary over time, which can contribute to rising rates of violence among adolescents, but due to a lack of data, this remains mere speculation.

The study also has its limitations. First, due to the cross-sectional nature of the surveys, it was not possible to assess the temporal order of changes in physical fighting and the included leisure time factors. The possibility of reverse causation may be of particular importance for some of the included factors, such as cannabis use. Second, the study was based on two time points only, thereby restricting the analyses to linear change instead of more complex time trends. Third, as the analyses were based on self-reports only, there is some uncertainty concerning the accuracy of the responses, particularly when non-normative behavior such as physical fighting is assessed. Fourth, several of the included variables were single item measures and may as such have rather low reliability. Fifth, leisure time that adolescents spend at home
and out with friends was assessed without providing information whether such activities were supervised by adults or not. As a result, considering such activities to be either supervised or unsupervised are based on implicit assumptions about what would be most common in these situations. Finally, even though physical fighting was assessed using identical initial wording in 2015 and 2018, the study is limited by the fact that physical fighting in 2015 was assessed using a combination of two items (physical fighting with and without a weapon), whereas only one overall item on physical fighting was used in 2018. The overall level of physical fighting in 2015 should not be influenced by using two items, as close to all respondents that reported fighting with weapons also reported fighting without. The respondents may still have interpreted physical fighting somewhat differently when asked explicitly about physical fighting with and without weapons, which might have influenced the reported level of fighting. Nevertheless, police reports from the same period corroborate the increase in physical fighting observed in the surveys, thereby strengthening the interpretations from the analyses. Apart from the instrument on physical fighting, all other items were measured identically in the two surveys.

Despite these limitations, this study highlights the importance of considering leisure time activities in violence prevention work among adolescents. Understanding the role of leisure time activities for changes in adolescent violent behavior can aid designing programs for prevention of adolescent aggressive acts and thereby help to reduce such behavior. Of special importance could be providing access to adult-supervised leisure time activities for adolescents at risk of problem behavior. Among Oslo youth, the increase in fighting co-occurred with an increase in leisure time spent hanging out with friends, and access to leisure activities where adults are present might have mitigated the increase. Concerning digital media use, the use among adolescents will to all appearances continue to increase, making it paramount for both youth workers and other adults to develop strategies to help children and adolescents navigate this new territory in a sensible way.

Conclusion

The present study used two population-based cross-sectional surveys among Norwegian adolescents to provide novel information about recent changes in the societal level of physical fighting and how such changes are related to co-occurring changes in leisure time activities. The study finds a significant increase in physical fighting among Norwegian adolescents from 2015 to 2018, among both boys and girls and in junior and senior high school. Several factors related to adolescent leisure time contributed to understanding the change in physical fighting: co-occurring increases in time spent unsupervised by adults, digital media use, and use of cannabis. The study thereby provides important information about how adolescents’ leisure activities are interwoven with adolescent problem behavior such as physical fighting. Of particular interest is the observed association between increasing digital media use and rising levels of physical fighting. This finding indicates that the recent years’ proliferation of smartphone use, by enabling adolescents to use digital media outside of the home and without adult presence, may have altered the previously observed association between digital media use and low levels of problems behavior.

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Authors’ Contributions L.R.F. conceived the study, participated in its design and coordination, performed the statistical analyses, and drafted the manuscript. A.B. was managing the data collection and contributed to draft the manuscript, and T.v.S. participated in design and interpretation of the statistical analyses and helped to draft the manuscript. All authors read and approved the final manuscript.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were approved by the Norwegian Centre for Research Data and were in accordance with the ethical standards of the Norwegian National Research Ethics Committees and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study. Parents of students younger than age 18 were given the option to decline their children’s participation.

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Appendix 1

Logistic regression analyses with physical fighting as dependent variable and year of survey and leisure time variables as predictors (boys). Mediation analyses are based on the product-of-parameters method.

<table>
<thead>
<tr>
<th>Relationship between predictor variable and physical fighting</th>
<th>Change in physical fighting from 2015 to 2018*</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR 99% CI Indirect effect 99% CI</td>
<td>OR 99% CI</td>
</tr>
</tbody>
</table>

Baseline model (without predictors) 1.51** [1.40, 1.63]

Model 1 (separate analyses for each predictor)

<table>
<thead>
<tr>
<th>OR 99% CI Indirect effect 99% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline model (without predictors) 1.51** [1.40, 1.63]</td>
</tr>
</tbody>
</table>

Note. Confidence intervals were calculated based on 1,000 bootstrap samples. Years of schooling, socioeconomic background, migration background, and school grades were included as control variables in all analyses. OR: odds ratio; 99% CI: 99% confidence interval of OR.

Indirect effect (mediation effect) of the association between survey year and physical fighting via leisure time variables. Indirect effects provide information about whether change in the included leisure time variables statistically reduce the estimate of change in physical fighting from 2015 to 2018.

The total indirect effect in Model 2 was estimated to 0.06 (p < 0.001, 99% CI [0.02, 0.10]), or 12.6% of the total effect.

Appendix 2

Logistic regression analyses with physical fighting as dependent variable and year of survey and leisure time variables as predictors (girls). Mediation analyses are based on the product-of-parameters method.

<table>
<thead>
<tr>
<th>Relationship between predictor variable and physical fighting</th>
<th>Change in physical fighting from 2015 to 2018*</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR 99% CI Indirect effect 99% CI</td>
<td>OR 99% CI</td>
</tr>
</tbody>
</table>

Baseline model (without predictors) 1.74** [1.52, 1.97]

Table (continued)

<table>
<thead>
<tr>
<th>Relationship between predictor variable and physical fighting</th>
<th>OR 99% CI Indirect effect 99% CI</th>
<th>Change in physical fighting from 2015 to 2018*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline model (without predictors) 1.74** [1.52, 1.97]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Confidence intervals were calculated based on 1,000 bootstrap samples. Years of schooling, socioeconomic background, migration background, and school grades were included as control variables in all analyses. OR: odds ratio; 99% CI: 99% confidence interval of OR.

Indirect effect (mediation effect) of the association between survey year and physical fighting via leisure time variables. Indirect effects provide information about whether change in the included leisure time variables statistically reduce the estimate of change in physical fighting from 2015 to 2018.

The total indirect effect in Model 2 was estimated to 0.06 (p < 0.001, 99% CI [0.02, 0.10]), or 12.6% of the total effect.

References


Statistical power analysis for the behavioral sciences.


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Adolescent boys’ physical fighting and adult life outcomes: Examining the interplay with intelligence

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Abstract
Although it is well known that adolescent delinquent behavior is related to poor outcomes in adulthood, longitudinal research on specific acts of delinquency and their interplay with important individual characteristics in predicting future outcomes is scarce. We aimed to examine how physical fighting—one of the most common acts of violent delinquency among adolescent boys—is related to adult life success in several domains, and how intelligence influences these associations. The study used data from 1,083 boys that participated in the population-based longitudinal Young in Norway Study, following adolescents from 1992 to 2015, by combining self-reports at four time points with comprehensive information from registers. Results showed that adolescent boys’ physical fighting was associated with poor adult outcomes in the domains of employment, education, and criminal behavior. Associations remained significant even after controlling for conduct problems in general—which isolated the effects of fighting from other delinquent acts—as well as from a variety of other potential confounders. Detailed analyses on the interplay of physical fighting and intelligence showed that some parts of the associations between adolescent boys’ fighting and several adverse adult outcomes could be ascribed to lower intelligence among the fighters. Moreover, intelligence moderated the relationship between physical fighting and adult education. Adolescent fighting was not related to educational attainment among boys with high intelligence, whereas boys with lower intelligence experienced detrimental effects of adolescent fighting. The analyses show the importance of considering adolescent boys’ physical fighting as a potential risk factor for future social marginalization.

KEYWORDS
adolescent, intelligence, juvenile delinquency, social marginalization, violence

1 | INTRODUCTION

A substantial amount of research links both adolescent delinquency (Bernburg & Krohn, 2003; Lanctôt, Cernkovich, & Giordano, 2007; Makarios, Cullen, & Piquero, 2017) and violent behavior (Kim, 2018; Tanner, Davies, & O’Grady, 1999; Wilczak, 2014) to adverse outcomes in adult life. Specific acts of delinquency may differ in their associations with future life outcomes. However, detailed knowledge of such relationships is limited. In particular, we know little about the long-term effects of physical fighting—a common act of violent delinquency among adolescent boys (Pickett et al., 2013). Physical fighting rarely results in any formal sanctions, and some adolescents even consider fighting an appropriate conflict-resolution tactic (Shetgiri, Lee, Tillitski, Wilson, & Flores, 2015), which points to
the importance of studying the long-term outcomes of engaging in this behavior.

Research has suggested that individual differences in cognitive abilities influence the outcomes of adolescent delinquency (Makarios et al., 2017). Cognitive abilities are also one of the most consistent predictors of adult life success in employment and education, even after taking adolescent delinquency into account (Tanner et al., 1999). However, there is a lack of studies that specifically consider the interplay of cognitive abilities and violent delinquency in affecting important life outcomes and no studies have examined physical fighting in this respect. A more thorough understanding of the complex interplay between physical fighting and cognitive abilities is essential for designing tailored interventions for youth with behavioral problems.

This study is the first to examine the long-term association between adolescent boys’ physical fighting and important adult life outcomes. To investigate the association, we use data from a large-scale longitudinal study following adolescent boys in Norway over a period of more than 20 years by means of questionnaires, as well as data from official education, employment, and crime registers. Furthermore, by utilizing test results from the National Conscript Service we provide new knowledge of how intelligence contributes to variations in the long-term outcomes of physical fighting in adolescent boys.

1.1 Adolescent violence and later life outcomes

A number of studies have linked adolescent delinquency to negative outcomes in adult life (e.g., Bernburg & Krohn, 2003; Lancot et al., 2007; Makarios et al., 2017). Two diverging theoretical accounts have been proposed for understanding this relationship, even though studies testing the explanations in relation to violent delinquency, in particular, are scarce (for an exception, see Kim, 2018). The first account views individual differences in personal characteristics as the prime explanatory factor of the association between adolescent delinquency and adult outcomes (e.g., Gottfredson & Hirschi, 1990). Specifically, it proposes that individual risk factors for both delinquency and life outcomes—such as disadvantageous personality traits, low self-control, or low intelligence—are the underlying reason for the association between these concepts. In other words, this perspective considers the relationship between adolescent delinquency and adult outcomes to be spurious, thereby implying that the association will diminish when accounting for individual differences in risk factors. In contrast, the second theoretical account—frequently referred to as the life-course theory of cumulative disadvantage—postulates that adolescent delinquency in itself has a direct, and possibly causal, influence on adult life outcomes (e.g., Moffitt, Caspi, Harrington, & Milne, 2002; Sampson & Laub, 1997). Specifically, it proposes that adolescents who perpetrate delinquent acts are stigmatized and excluded. These reactions by society, in turn, impede individuals’ pathways to successful adult life. Moreover, limited options for a successful normal life may intensify a delinquent lifestyle and result in more socialization with other delinquents, thereby reinforcing processes of delinquency and marginalization. Previous research has termed these processes “labeling,” “stigmatization,” and “snaring” (Bernburg & Krohn, 2003; Moffitt et al., 2002).

Both theoretical accounts have received empirical support. In accordance with Gottfredson and Hirschi’s (1990) assumptions, individual differences in self-control (Gottfredson & Hirschi, 1990) and cognitive abilities (Tanner et al., 1999) have been identified as confounding factors in the relationship between adolescent delinquency and life success in adulthood. Similarly, controlling for both observed and unobserved family factors by using family fixed effects models substantially reduced the observed relationship between violent delinquency and educational outcomes (Kim, 2018). Conversely, studies also show how labeling through criminal justice involvement during adolescence impedes later life opportunities (e.g., Bernburg & Krohn, 2003; Lopes et al., 2012). Wertz et al. (2018) included factors related to both of the theoretical accounts in combined analyses and found that severe childhood conduct problems contributed to an increased risk of adult life failure even when accounting for genetic and environmental familial risk and concurrent adult psychopathology. However, including familial risk factors in the analyses reduced the impact of childhood conduct problems, thereby supporting both theoretical accounts. Other empirical studies have drawn similar conclusions (Makarios et al., 2017; Piquero, Farrington, Nagin, & Moffitt, 2010).

Even though there is evidence supporting both theoretical accounts, the mechanisms at play may vary for different delinquent acts. For example, in Tanner et al.’s (1999) study, school truancy was negatively related to a variety of future educational outcomes also after accounting for other types of delinquent behavior, even though the severity of the act is negligible. Similarly, the association between contact with the criminal justice system during the adolescent years and most outcomes has been shown to be stronger than the associations for other forms of delinquency (Tanner et al., 1999). Researchers have also found violent and nonviolent delinquency to differ in their associations with educational outcomes (Kim, 2018). Therefore, more knowledge about how separate domains of delinquency influence adult outcomes is important for an increased understanding of the mechanisms at play in these relationships. This might be particularly relevant for a behavior such as physical fighting, which is quite common among adolescent boys and in addition often remains unsanctioned.

Only three studies have so far considered the specific association between violent delinquency and adult life outcomes. Tanner et al. (1999) found that boys’ delinquency during adolescence significantly predicted a range of educational and employment outcomes in young adulthood, such as educational attainment, unemployment, and job status. However, when including several relevant confounders in the analyses, such as sociodemographic characteristics, cognitive abilities, and educational expectations, violent delinquency no longer showed significant associations with earning a high school diploma and occupational status, and associations with other outcomes were significantly weakened. When additionally adjusting for other forms of delinquent behavior, such as contact with the criminal justice system, drug use, and property crime, violent delinquency was no longer related to any of the outcomes. Similar results were obtained by Kim (2018). The study initially identified a
consistent association between violent delinquency and educational outcomes among adolescent boys and girls; however, when analyzing sibling pairs in family fixed effects models, and thereby accounting for both measured and unmeasured environmental influences, close to all of the associations between violent delinquency and educational outcomes disappeared. Finally, Wilczak (2014) also identified a significant relationship between violent perpetration among boys and girls during high school and educational success in young adulthood. The relationship remained significant after controlling for a variety of factors such as violent victimization in both adolescence and young adulthood, violent perpetration in young adulthood, socioeconomic factors, neighborhood characteristics, and self-control. The study did not control for cognitive abilities and other forms of adolescent delinquency, however.

Thus, the available studies reach somewhat different conclusions regarding the associations between violent delinquency and adult life outcomes. Whereas all studies found an initial association between violent delinquency and later life outcomes, some were able to account for the relationship by including relevant control variables in the analyses but others were not. One important consideration is whether it is appropriate to account for other forms of conduct problems in the analyses. Controlling for conduct problems strengthens the possibility of identifying negative outcomes of violent delinquency that are not caused by attributes related to a delinquent lifestyle in general (Gottfredson & Hirschi, 1990). Previous research also points to other important confounding factors when considering potential mechanisms for understanding the relationship between violent delinquency and adult life outcomes, such as cognitive abilities, family background, and social relationships.

### 1.2 The interplay between delinquency and intelligence

As suggested by Tanner et al. (1999), cognitive abilities might be an important confounder of the relationship between adolescent delinquency and adult life outcomes. If this is true, some parts of the observed association between delinquent behavior and adult outcomes are the result of initial differences in cognitive abilities and statistically controlling for cognitive abilities should reduce the observed associations. In line with this suggestion, previous research has linked low intelligence to boys’ physical fighting (Loeber, Green, Lahey, & Kalb, 2000) and more generally to the perpetration of violence for both genders (Jacob, Haro, & Koyanagi, 2019). Possible explanations of the observed association are intelligence-related deficits in personal and social competencies, such as communication skills (Crick & Dodge, 1994) and self-control (Gottfredson & Hirschi, 1990); these deficits, in turn, may elicit aggressive and violent behavior.

The association between intelligence and adult life outcomes is also well established in previous research. In a meta-analytic review, Strenze (2007) analyzed the longitudinal relationship between intelligence in childhood and adolescence and socioeconomic success in adult life. Intelligence was strongly related to education when measured by years of obtained education ($r = .56$; 59 data sets, $N = 84,828$). Moreover, intelligence was associated with occupational level, typically measured by instruments assessing the desirability and prestige of different occupations, with an overall correlation of $r = .43$ (45 data sets, $N = 72,290$). Finally, intelligence correlated $r = .20$ with income, measured by salary or total monetary income (31 data sets, $N = 58,758$). Thus, research consistently shows intelligence to be prospectively related to future academic, occupational, and financial success. Recent research additionally indicates that the association between education and intelligence might be reciprocal, as a large meta-analysis of quasi-experimental studies estimating the causal effect of education on intelligence have shown that each additional year of education was related to an increase of 1–5 IQ points (Ritchie & Tucker-Drob, 2018). Evidence from prospective longitudinal studies also shows that high intelligence protects against future violent behavior, violent crimes, and criminal offending in general (Barker et al., 2007; Schwartz et al., 2015; Ttofi et al., 2016). These empirical findings indicate that cognitive abilities may influence both physical fighting and future adult life outcomes and may, therefore, function as a confounder inducing a spurious relationship between adolescent boys’ fighting and adult life outcomes. However, the degree to which cognitive abilities act as a confounder of this relationship has not been tested directly up to now.

Cognitive abilities may also influence the relationship between delinquency and future outcomes in other complex ways. For example, adolescents with higher intelligence may use violence in a more instrumental manner than adolescents with lower intelligence do, or they may be better at avoiding negative consequences of fighting from their environment. Hence, people with higher intelligence might act in ways that make them resilient to the long-term consequences of adolescent violence. In other words, intelligence may function as a moderator, where the relationship between adolescent fighting and important life outcomes would be weaker for adolescents with high intelligence than for adolescents with lower intelligence. Empirical studies investigating such potential moderating effects of intelligence on violent delinquency in relation to future later life outcomes are lacking. However, in related research, Makarios et al. (2017) found a moderating effect of vocational aptitude—a test of cognitive abilities—on adolescent delinquency concerning some adult outcomes. The analyses showed that the association between adolescent delinquency and both graduation from high school and adolescent pregnancy was stronger among those with low vocational aptitude. Yet, no moderation of vocational aptitude was identified for enrolling in college, labor market marginalization, and two measures of sexual risk behavior.

In the present study, we consider intelligence as both a potential confounder and a moderator in the relationship between adolescent boys’ physical fighting and adult life outcomes.

### 1.3 Gender differences in physical violence

Violence, and particularly serious physical violence, tends to be classified as a typical male behavior (Baxendale, Cross, & Johnston, 2012) and empirical studies have found approximately twice the rate of physical fighting in boys compared to girls (Kann et al., 2018). Violent behavior among women has also been considered
incompatible with society’s cultural stereotypes for feminine behavior (Gilbert, 2002). Given that physical violence is less prevalent among girls and a less normative act than fighting among boys, one might hypothesize that the long-term negative outcomes of physical violence perpetration might be more profound for girls than for boys. However, Tanner et al. (1999) showed that the negative effects of violent delinquency on educational and occupational outcomes did not differ across gender or even were smaller for girls than boys for some outcomes. Other studies including both boys and girls have not examined whether long-term outcomes of adolescent violence differed across gender (e.g., Kim, 2018; Wilczak, 2014) and research on this issue is thus sparse. The present study investigates long-term outcomes of boys’ physical fighting only and future research should address if such findings can be generalized to girls as well.

1.4 The present study

In summary, research on the relationship between adolescent physical fighting—one of the most common acts of violent delinquency among adolescent boys—and adult life outcomes is scarce and studies on the complex interplay between physical fighting and intelligence are lacking. The present study addresses this study gap. Specifically, the aim of the study was to investigate how adolescent boys’ physical fighting was related to adult life outcomes in several domains, such as employment, education, and crime, and to explore the interplay between physical fighting and intelligence in the observed relationships. For this purpose, we analyze survey data from a sample of 1,083 boys from a longitudinal study of Norwegian adolescents followed over a 13-year period from 1992 to 2015, with linkage to data on life outcomes from official registers and to intelligence test data from the Norwegian National Conscript Service. Based on previous research on the associations between adolescent boys’ delinquency and life outcomes, we expect that physical fighting would be related to adverse adult life outcomes in employment, education, and crime. Moreover, we expect that some of the associations between physical fighting and adult life outcomes would be accounted for by confounders such as intelligence, other forms of delinquent behavior, family background, and delinquent peer relations. We will scrutinize in detail the confounding effects of intelligence by means of formal confounder analyses, and we expect that individual differences in intelligence would explain some of the negative outcomes of adolescent boys’ physical fighting. Finally, we expect that the negative associations between physical fighting in adolescence and adult life success are moderated by intelligence.

2 METHODS

2.1 Procedure and participants

The present study used questionnaire data from the Young in Norway Study, collected at four-time points: 1992 (T1), 1994 (T2), 1999 (T3), and 2005 (T4) (see von Soest, Wichstrøm, & Kvalem, 2016). These data were linked to time series data from official registers and to intelligence test data from the Norwegian National Conscript Service. The study initially included a nationally representative sample of students in junior and senior high school (age 13–18), with 12,287 participants and a response rate of 97%. At T2, students who still attended the same school as at T1 were followed up with questionnaires at school. A sizable portion of the students had completed their 3-year track at the junior or senior high school that they attended at T1, and received the T2 questionnaire by mail. The response rate of those still attending the same school at T2 was 92%, while the response rate among those who received the questionnaires by mail was significantly lower. Only students who completed the questionnaire at school at T2 (n = 3,844) were followed up at T3 and T4. The study was originally planned to be a two-wave study, so new informed consent had to be obtained at T2. Those then consenting (n = 3,507; 91%) received questionnaires by mail at T3 and T4, with data received from 2,924 (84%) and 2,890 (82%) participants, respectively. At T4, the respondents were asked for their consent to link the data to several registers, to which 2,606 respondents (90%) agreed, of whom 1,147 were boys. The overall participation rate of the final sample, based on all eligible students at T1 who still were at their original school at T2, was, therefore, 68% at T3, 67% at T4, and 60% concerning the assessment of register data.

Intelligence test scores were available only for boys, thereby restricting the sample included in the present study to boys who had valid intelligence test scores and consented to linking of the data to official registers. Sixty-two boys were excluded due to missing intelligence test scores, and two boys withdrew their consent to data linkage, leaving a total sample of 1,083 boys. All participants agreed to participate both orally and in writing, and the parents of participants younger than 16 years at T1 also consented to their children’s participation in the survey. The Norwegian Data Inspectorate and the Regional Committee for Medical Research Ethics approved the study. The procedures have been thoroughly presented in previous publications (von Soest et al., 2016).

Attrition was examined by means of bivariate logistic regression analyses. Results showed that older age (odds ratio [OR] = 1.36; \( p < .01 \)), higher levels of conduct problems in both the respondents (OR = 1.17; \( p = .03 \)) and the respondents’ friends (OR = 1.07; \( p < .01 \)), and having a migration background (OR = 3.68; \( p < .01 \)) were related to attrition. Attrition was not related to physical fighting. Attrition analyses could not be conducted for variables assessed by means of register data (i.e., intelligence and outcome variables) because the data set only contained register data for those responding at T4, and not the entire initial sample.

2.2 Measures

2.2.1 Physical fighting

Physical fighting was assessed at T2 by two items about the frequency of physical fighting during the previous 12 months. One question asked about physical fighting where respondents had used a
for a criminal offense in the period 1996–2014. Another dummy variable contrasted charges for violent crimes with not having been charged for any crime or having been charged only for nonviolent crimes. We restricted assessing charges to 1996 and later, so as not to include criminal activity that had occurred before the respondents answered the questions about physical fighting in 1994.

2.2.4 | Confounders

Several variables were included in the analyses as additional confounders of the relationship between adolescent boys’ physical fighting, intelligence, and later life outcomes. First, register data were used to measure the highest level of education attained by parents when the respondent was 16 years old, ranging from 1 (junior high school or lower education) to 4 (higher university degree). Second, respondents’ conduct problems at T2 were assessed by a 15-item instrument (α = .76) based on the DSM-III-R criteria for conduct disorder. The instrument assessed the frequency of participants’ conduct problems during the previous 12 months on a 6-point scale, ranging from never to more than 50 times. Items ranged from rather common behavior, such as school truancy, to more serious behaviors, such as stealing and vandalism. Third, the respondent’s two best friends engaging in four different kinds of problematic conduct in the last 12 months was assessed at T2; smoking cigarettes, alcohol use at least weekly, smoking cannabis, and being involved with the police. The variable was generated as a sum of numbers of yes on the four questions, ranging from 0 to 8 (α = .76). Fourth, age was assessed by means of data from official registers. Finally, migration background was defined by having two foreign-born parents.

2.3 | Statistical analyses

All life outcomes were included as dependent variables in separate regression analyses, with physical fighting and intelligence as the main independent variables. Logistic regression analyses were used for dichotomous outcomes and linear regression analyses for continuous outcomes. The regression analyses were conducted in several steps. In the first model, two dummy variables measuring physical fighting were included as predictors together with age and migration background as control variables. In a second model, intelligence was added as a predictor. The third model included parental education and the respondent’s and respondent’s friends’ conduct problems as additional covariates. In the next set of analyses, the confounding effects of intelligence in the relationship between physical fighting and life outcomes were assessed by tests comparable to mediation analyses. As suggested by MacKinnon, Krull, and Lockwood (2000), confounder effects were assessed by means of the product of coefficients approach in a path-analytic framework, and bias-corrected standard errors were obtained based on 5,000 bootstrap samples (Hayes, 2018). Finally, interaction terms between intelligence and the dichotomous instrument measuring physical fighting were assessed to examine possible moderating effects of intelligence in the relationship between physical fighting
and life outcomes. Significant moderation effects were further probed by using the Johnson-Neyman technique of regions of significance (Johnson & Neyman, 1936), as well as simple slope analyses of conditional effects estimated based on results from the moderation analyses (Hayes, 2018).

All analyses except model diagnostics for the logistic models were conducted using the statistical package Mplus Version 7.4. Missing data were handled by the full information maximum likelihood procedure, thereby providing missing data routines that are considered to be state of the art (Schafer & Graham, 2002). Nagelkerke $R^2$ and Hosmer-Lemeshow goodness-of-fit in logistic regression models were estimated using IBM SPSS Statistics 25 where missing data were handled by a listwise deletion procedure.

3 | RESULTS

3.1 | Descriptive statistics

Of the participating boys, 66.1% reported not having been involved in physical fighting the previous year. Of the remaining boys, 16.5% had been involved in one fight, and 17.4% had been involved in two or more fights. As Table 1 shows, reporting at least one instance of physical fighting correlated $-0.18$ ($p < 0.001$) with intelligence, indicating that boys with higher intelligence engaged in physical fighting less often than boys with lower intelligence. Both physical fighting and intelligence were correlated negatively with physical fighting and all but one of the adverse outcomes and correlated positively with intelligence and all positive outcomes ($p < .01$). The respondent’s conduct problems correlated in the opposite direction with the same variables ($p < .05$), while the respondent’s friends’ conduct problems correlated similarly with all measures except labor market marginalization.

### TABLE 1

<table>
<thead>
<tr>
<th>Correlations</th>
<th>M (SD) or %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1. At least one instance of physical fighting</td>
<td>33.9</td>
</tr>
<tr>
<td>2. Intelligence (1–9)</td>
<td>5.83 (1.64)</td>
</tr>
<tr>
<td>3. Any criminal charges 1996–2014 (yes)</td>
<td>20.8</td>
</tr>
<tr>
<td>4. Charged with violent crime 1996–2014 (yes)</td>
<td>3.5</td>
</tr>
<tr>
<td>5. Education level in 2015 (1–5)</td>
<td>3.59 (1.08)</td>
</tr>
<tr>
<td>6. Average income 2012–2014 (10 deciles)</td>
<td>5.5 (2.87)</td>
</tr>
<tr>
<td>7. Labor market marginalization 2012–2014 (yes)</td>
<td>3.8</td>
</tr>
<tr>
<td>8. Parental education (1–4)</td>
<td>2.51 (0.82)</td>
</tr>
<tr>
<td>9. Conduct problems T2 (1–6)</td>
<td>1.46 (0.45)</td>
</tr>
<tr>
<td>10. Friends’ conduct problems T2 (0–8)</td>
<td>1.21 (1.69)</td>
</tr>
<tr>
<td>11. Age</td>
<td>15.2 (1.95)</td>
</tr>
<tr>
<td>12. Migration background (yes)</td>
<td>1.2</td>
</tr>
</tbody>
</table>

*p < .05.
**p < .01.
***p < .001.
included as an additional covariate. The results showed high intelligence to be related to a higher degree of life success for all adult outcomes. Including intelligence in the model also reduced the coefficients for physical fighting. In Model 3, parental education and both the respondent’s and respondent’s friends’ conduct problems were included as additional confounders. After including confounders, the relationship between boys’ physical fighting and all outcomes except income remained statistically significant. Concerning educational attainment and being charged with a crime, only participation in two or more fights the previous year remained significantly related to the outcomes.

### 3.3 The interplay between adolescent boys’ physical fighting and intelligence

Confounder effects of intelligence in the relationship between adolescent boys’ physical fighting and adult outcomes were analyzed using the product of coefficients approach. Physical fighting was included as a dichotomous variable in the analyses, and age, migration background, parental education, and the respondent’s and respondent’s friends’ conduct problems were added as confounders. For two of the five outcomes, intelligence was a significant confounder in the relationship between adolescent boys’ physical fighting and adult outcomes. Regarding violent crime, the confounder effect of intelligence was estimated to -0.04 (p = 0.030; 95% CI [−0.08; -0.01]). This is equal to 11.6% of the total estimated effect. Labor market marginalization showed a similar coefficient, with a confounder effect of -0.03 (p = 0.027; 95% CI [-0.07; -0.01]), equaling to 8.1% of the total estimated effect. Hence, individual differences in intelligence accounted for some part of the negative association of boys’ physical fighting with adult life outcomes. Intelligence was not a significant confounder for being charged with a crime (confounder effect = -0.01; p = 0.053; 95% CI [-0.03; 0.00]), education level (0.00; p = 0.073; 95% CI [0.00; 0.01]), and income (−0.01; p = .190; 95% CI [-0.02; 0.00]).

In a final step, we investigated whether individual differences in intelligence moderated the long-term outcomes of adolescent boys’ physical fighting by estimating regression analyses where interaction terms between intelligence and the dichotomous physical fighting variable were additionally added (analyses not shown in tables). The interaction term reached significance only with education level as an outcome (p = .031). Figure 1 provides a graphical representation of the interaction effect by depicting the estimated relation between adolescent boys’ physical fighting and the respondents’ highest attained education level in 2015 for five groups; boys with an
<table>
<thead>
<tr>
<th></th>
<th>Education level attained (1-5)</th>
<th>Average income (10 deciles)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b [95% CI]</td>
<td>β</td>
</tr>
<tr>
<td>Model 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No physical fighting (ref.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once instance of fighting</td>
<td>-0.36 [−0.54; −0.18]***</td>
<td>-0.12</td>
</tr>
<tr>
<td>Two or more instances of fighting</td>
<td>-0.71 [−0.90; −0.52]***</td>
<td>-0.25</td>
</tr>
<tr>
<td>R²</td>
<td>.06</td>
<td></td>
</tr>
<tr>
<td>Model 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No physical fighting (ref.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once instance of fighting</td>
<td>-0.27 [−0.44; −0.11]***</td>
<td>-0.09</td>
</tr>
<tr>
<td>Two or more instances of fighting</td>
<td>-0.53 [−0.72; −0.36]***</td>
<td>-0.19</td>
</tr>
<tr>
<td>Intelligence (1–9)</td>
<td>0.23 [0.19; 0.26]***</td>
<td>0.34</td>
</tr>
<tr>
<td>R²</td>
<td>.18</td>
<td></td>
</tr>
<tr>
<td>Model 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No physical fighting (ref.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once instance of fighting</td>
<td>-0.12 [−0.29; 0.04]</td>
<td>-0.04</td>
</tr>
<tr>
<td>Two or more instances of fighting</td>
<td>-0.24 [−0.44; −0.04]**</td>
<td>-0.08</td>
</tr>
<tr>
<td>Intelligence (1–9)</td>
<td>0.19 [0.15; 0.23]***</td>
<td>0.29</td>
</tr>
<tr>
<td>Parental education (1–4)</td>
<td>0.24 [0.16; 0.31]***</td>
<td>0.18</td>
</tr>
<tr>
<td>Conduct problems T2 (1–6)</td>
<td>-0.35 [−0.53; −0.18]***</td>
<td>-0.14</td>
</tr>
<tr>
<td>Friends’ conduct problems T2 (0–8)</td>
<td>-0.04 [−0.08; 0.00]</td>
<td>-0.06</td>
</tr>
<tr>
<td>R²</td>
<td>.23</td>
<td></td>
</tr>
</tbody>
</table>

Note: Age (centered) and migration background were included as control variables.

Abbreviations: 95% CI, 95% confidence interval of b; b, unstandardized regression coefficient; β, standardized regression coefficient.

*p < .05.
**p < .01.
***p < .001.
4 | DISCUSSION

Even though previous research has shown that adolescent violent delinquency is related to adverse outcomes in adult life (e.g., Kim, 2018; Tanner et al., 1999; Wilczak, 2014), no study has explicitly considered one of the most frequent acts of violent delinquency among adolescent boys—physical fighting. This study contributes toward filling this knowledge gap and presents findings that emphasize the importance of considering physical fighting among adolescent boys as a putative risk factor of future social marginalization. The analyses showed that adolescent boys’ physical fighting, and particularly repeated physical fighting, was related to adverse adult outcomes in employment, education, and crime, even after taking other forms of conduct problems into account. Moreover, the study presents new knowledge regarding the interplay of adolescent boys’ physical fighting and intelligence in predicting adult life success. Individual differences in intelligence accounted for 8%–12% of the association between boys’ physical fighting and adult life success for two of five included outcomes, even when controlling for relevant covariates. In addition, adolescent physical fighting had a significantly stronger negative impact on future educational success for boys with a lower intelligence level than for boys with a higher intelligence level.

4.1 | The relationship between adolescent boys’ physical fighting and life outcomes

The consistent association between adolescent boys’ physical fighting and adverse adult life outcomes is in line with previous studies on negative effects of both adolescent delinquency in general (Bernburg & Krohn, 2003; Lanctôt et al., 2007; Makarios et al., 2017) and violent delinquency in particular (Kim, 2018; Tanner et al., 1999; Wilczak, 2014). To account for the possibility that the observed negative effect of boys’ physical fighting was just a result of a general tendency to participate in delinquent behavior, we adjusted for the occurrence of other forms of conduct problems. Conduct problems, in general, did account for some of the association between physical fighting and adult life outcomes. However, physical fighting remained significantly related to most outcomes even after this adjustment, thereby indicating that associations between adolescent boys’ fighting and adult life outcomes could not be explained solely by an underlying higher level of conduct problems among the fighters. An explanation for these findings is that fighting—even though rarely formally sanctioned—may be viewed as particularly undesirable by both peers and adults alike, because the behavior may lead to physical harm of another person. As a result, adolescents involved in physical fighting may—to a greater degree than other adolescents with conduct problems—be labeled with undesirable characteristics, which in turn may lead to long-term marginalization processes over and above those elicited by general conduct problems. The remaining significant associations of adolescent boys’ physical fighting with adult life outcomes even after accounting for confounders is partly in contrast to Tanner et al.’s (1999) findings, where the association between delinquent acts and adult life outcomes diminished to insignificance when adjusting for covariates. Similarly, the association between violent delinquency and educational outcomes was completely accounted for when adjusting for observed and unobserved
family characteristics by means of sibling fixed effects in another study (Kim, 2018). Our results, therefore, raise the question of whether adolescent boys’ physical fighting should be conceptualized differently than other forms of delinquent behavior.

Theoretically, the analyses provide support to the notion of cumulative disadvantage, of adolescent delinquency having direct and potentially causal, effects on later life success. Even when several highly relevant control variables were included, such as cognitive abilities, parental education, and both the respondent’s and respondent’s friends’ conduct problems, most of the associations between adolescent boys’ physical fighting and life outcomes were not reduced to insignificance. However, including intelligence and other confounding variables in the analyses contributed to a reduction in the coefficient for physical fighting, indicating that other mechanisms than the direct association between fighting and adult outcomes are also at play. In addition, since confounding factors that were not assessed in the present study, such as self-control, might also confound the association between adolescent boys’ physical fighting and adult outcomes, it would be premature to draw a final conclusion regarding the observed association.

4.2 The interplay between adolescent boys’ physical fighting and intelligence

In line with Tanner et al. (1999), the present study showed that intelligence was a significant confounder in the relationship between adolescent boys’ physical fighting and several of the measured life outcomes. These results lend support to the notion that parts of the relationship between adolescent delinquency and adult outcomes originate from a spurious association induced by individual differences in stable individual characteristics, such as intelligence. Previous research has suggested that intelligence is related to personal or social competencies that inhibit aggressive and violent behavior (Crick & Dodge, 1994; Gottfredson & Hirschi, 1990) and may, therefore, decrease engagement in physical fighting. Further, high intelligence and the better social competencies generated by it may also be related to adult life outcomes in the educational and occupational domains, inducing the observed spurious relationship. The confounding effects retained their significance even after accounting for parental education, both the respondent’s and respondent’s friends’ conduct problems, age, and migration background. However, the confounder effects were found for only two of the five included outcomes and were rather small (8%–12% of the total effect), thereby indicating that intelligence may be one of a multitude of confounders of the relationship between adolescent boys’ physical fighting and future life outcomes.

The results of our analyses also revealed a significant moderating effect of intelligence in the relationship between physical fighting and the boys’ attained education level. Among boys with higher intelligence, adolescent physical fighting did not affect their education level as adults. However, boys with lower intelligence reported fewer years of education attained if they fought during their adolescent years. The observed interaction between adolescent boys’ physical fighting and intelligence concerning the attained education level is partly similar to Makarios et al.’s (2017) findings of a significant interaction between adolescent delinquency and vocational aptitude in predicting graduation from high school. Intelligence is an important factor when it comes to the education level attained \( r = .38 \), and it seems likely that high intelligence may protect boys from the negative effects of fighting through several different mechanisms. Boys with higher intelligence may be more careful in the selection of situations where they choose fighting as an appropriate act, such as when the cause seems more just or when the act is not observed by others, which again may result in both fewer immediate sanctions and less profound long-term consequences of the act. Further, high intelligence can foster resilience against the potential damaging effects of adolescent boys’ physical fighting through the amount of cognitive resources available to cope adequately with the negative consequences of fighting. In short, the analyses concerning education show that compared to boys with lower intelligence, boys with higher intelligence fight more seldom, and when they do fight, their cognitive resources may enable them to mitigate the long-term consequences of their adolescent acts.

4.3 Strengths and limitations

The present study provides evidence of a long-term association between adolescent boys’ physical fighting and life success in adulthood based on data from a variety of sources: a nationally representative, large-scale survey following participants from adolescence into early adulthood, data from official registers, and intelligence test data. The study has limitations, however. Even though the longitudinal nature of the study and adjustment for a variety of relevant confounders provide important information on the temporal association between adolescent boys’ physical fighting and adult life outcomes, the associations may also be explained by unobserved confounders. Previous research has suggested several possible confounding factors that are not measured in this paper such as violent victimization, neighborhood factors, and self-control. Being able to include self-control, other factors related to personality, and neighborhood factors in the analyses would have strengthened the study. Further, the time point of the assessment of intelligence succeeded the measurement of physical fighting. This could open the possibility that low intelligence test scores in young adulthood are in part a consequence of an antisocial lifestyle and low academic interest during adolescence, rather than a precursor of physical fighting. However, previous research has shown that intelligence is rather stable during adolescence and young adulthood (Deary, 2014). Therefore, the subsequent assessment of intelligence should not have had a major impact on the results from the analyses. Finally, generalizability might be an issue worth discussing. Norway has a low rate of violent crime, unemployment rates are very low, and the social security network is tight, which all might influence the identified association between adolescent boys’ physical fighting and adult life success. However, the analyses still show detrimental long-term effects of physical fighting among Norwegian boys, a finding that we expect to be even more profound in countries with a weaker social security network. Moreover, only boys were included in the study and studies are lacking on whether results can be generalized to girls. Future research should examine whether associations between physical fighting
and life outcomes may be even more pronounced among girls, because physical violence is less frequent (Kann et al., 2018) and considered less normative among girls than among boys (Gilbert, 2002).

5 | CONCLUSIONS

This study is the first to consider long-term outcomes of one of the most frequent acts of violence among adolescent boys—physical fighting. The study also provides new knowledge about mechanisms of the interplay between adolescent boys’ physical fighting and intelligence in explaining adult outcomes. In general, boys’ physical fighting is related to adverse adult outcomes in employment, education, and crime. Further, individual variation in intelligence is relevant for understanding the association between adolescent boys’ physical fighting and adverse adult outcomes. Boys with higher intelligence participate less often in physical fighting than boys with lower intelligence, inducing a spurious relationship between adolescent fighting and some adult life outcomes. However, direct associations between fighting and most of the measured outcomes also persist in the final analytic models, and intelligence explains only a small part of the associations between fighting and life outcomes. The analyses also revealed an interaction effect concerning educational outcomes. Boys with high intelligence attained equally high levels of education, independent of whether or not they report fighting during their adolescent years. In contrast, fighting was related to fewer years of education for boys with average and low intelligence. Even though intelligence often is considered a non-modifiable risk factor in relation to future life outcomes, the identified interplay between adolescent boys’ physical fighting and intelligence shows that both fighting and cognitive abilities should be considered when designing interventions aimed at reducing negative long-term outcomes of adolescent conduct problems.

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