DOI: https://doi.org/10.14393/REE-v40n1a2025-72770
Instituto de Economia e Relações Internacionais – Universidade Federal de Uberlândia

economia
ensaios

Sports and Education: Causal Paths of Criminality in Minas Gerais Municipalities

Como esporte e educação compõem caminhos causais da criminalidade nos municípios mineiros

Igor Oliveira Santos Roson [a]
Suzana Quinet de Andrade Bastos [b]
Sandro de Freitas Ferreira [c]

Abstract: This study analyzes the causal conditions behind crime determinants, focusing on the relationship between education, sports, and crime. It draws on data from the Índice Mineiro de Responsabilidade Social (IMRS – *Minas Gerais Social Responsibility Index*) for municipalities in Minas Gerais in 2016. The method used is Qualitative Comparative Analysis (QCA), which allows identifying the relationships between conditions and observed outcomes. The results indicate that sports and education are inversely associated with crime (except for violent crimes against persons) and jointly constitute at least one causal path to low crime rates, excluding crimes against persons.
Keywords: sports; education; economics of crime; Minas Gerais; Qualitative Comparative Analysis.
JEL Classification: I29; K42; Z29.

Resumo: O presente estudo propõe analisar as condições causais dos determinantes da criminalidade, focando na relação da educação e do esporte com o crime, utilizando dados do Índice Mineiro de Responsabilidade Social (IMRS) para os municípios de Minas Gerais em 2016. Foi utilizado o método de Análise Qualitativa Comparativa (QCA) para detectar as relações entre as condições e os resultados experimentados. Os resultados mostram que esporte e educação têm uma relação oposta com o crime (exceto o crime violento contra a pessoa) e compõem conjuntamente ao menos um caminho causal para o baixo crime (exceto o crime contra a pessoa).
Palavras-chave: esporte; educação; economia do crime; Minas Gerais; Análise Qualitativa Comparativa.
Classificação JEL: I29; K42; Z29.

[a] PhD student in Economics at the Institute of Economic Research of the University of São Paulo (IPE-USP). Email: igorroson@gmail.com. ORCID: https://orcid.org/0000-0001-9254-4301
[b] Professor of the Graduate Program in Economics at the Federal University of Juiz de Fora (PPGE-UFJF) and CNPq level C productivity scholarship holder. Email: quinet.bastos@gmail.com. ORCID: https://orcid.org/0000-0002-8080-1486
[c] Postdoctoral Fellow in Economics in the Graduate Program in Economics of the Federal University of Juiz de Fora (PPGE-UFJF). Email: sandroffbr@gmail.com. ORCID: https://orcid.org/0000-0001-5762-5966

1. Introduction

Crime remains a persistent social problem in Brazil, closely linked to a range of socioeconomic disturbances and generating negative externalities for society (Freeman, 1999). In Minas Gerais, homicide rates per 100,000 inhabitants have shown an upward trend since 1980. These rates remained relatively stable until the 1990s, then sharply increased towards the late 1990s and early 2000s. Since 2000, crime levels in the state have settled at a higher plateau, fluctuating around 20 homicides per 100,000 inhabitants (rising to 50 when considering only the youth population). According to data from the Atlas da Violência (2023), this rate was below 10 homicides per 100,000 inhabitants until the early 1990s.

Crime is influenced by a variety of factors spanning from individual and community levels to broader societal dimensions, including socioeconomic determinants such as unemployment, poverty, inequality, and the lack of effective public policies. The economic study of crime has focused on identifying its determinants as well as proposing public policies capable of reducing the negative externalities associated with illicit activities. Crime is a complex phenomenon, and its control requires a set of integrated public policies; among these, policies aimed at promoting education and sports participation can contribute to crime prevention, particularly among youth. This is because such policies enhance human and social capital, foster social inclusion and control, promote pro-social development and personal skills, encourage civic behavior, and engage young people productively (or incapacitate them from engaging in criminal activities).

However, empirical literature has yet to reach a consensus regarding the relationship between crime and education or sports. The literature investigating the effects of education on crime is extensive, with several studies pointing to an inverse relationship between education and crime (Lochner and Moretti, 2004; Buonanno and Leonida, 2006; Machin *et al.*, 2011; Machin *et al.*, 2012; Hjalmarsson *et al.*, 2015); except for "white collar" crimes (Groot and Van Den Brink, 2010). Most national empirical studies identify education as a variable negatively related to crime levels in Brazil (Teixeira, 2011; Becker, 2012; Araújo Jr. *et al.*, 2012). On the other hand, the international literature on the crime-sport relationship is nascent, but most findings indicate a negative correlation (Hartmann and Depro, 2006; Hartmann and Massoglia, 2007; Caruso, 2011; Veliz and Shakib, 2012; Brosnan, 2019). This holds true with some exceptions, depending on the specific sport and crime type. In the national literature, to date, only the work by Roson *et al.* (2022) has explored this topic, identifying a negative correlation between homicides and the level of sport participation across Brazilian municipalities. Ultimately, existing studies tend to examine education and sport in isolation. Thus far, a joint empirical approach integrating crime, sport, and education has not been found. This study, therefore, seeks to fill this gap in the literature.

Given the inherent complexity of the criminal phenomenon—both concerning the multifaceted influence of its potential factors (individual, micro-environmental, and macro-environmental) and the extensive interplay among them—employing methods that

acknowledge this complexity could yield valuable insights for public policy discussions aimed at controlling and reducing crime. Thus, the objective—distinct from the econometric pursuit of causal or correlational relationships—is to explore an alternative concept of causality as a preliminary step to the traditional approach: the concept of complex conjunctural causality from Configurational Analysis (CA). While CA does not offer techniques for measuring specific functional relationships among the aforementioned factors, it allows for verifying the properties of sufficiency and necessity between these factors and the social phenomenon of interest. In the context of crime, the aim is to identify such properties between specific crime categories and the conditioning factors commonly used in economic crime research.

The approach employed differs from the more traditional empirical literature by investigating the empirical consistency of the causal relationship between phenomena. This means assessing whether, whenever a specific causal condition or combination thereof is empirically present in a given macrosocial unit (e.g., a municipality), the explained phenomenon (e.g., a crime or crime categories) is also empirically present. Since CA is founded on Set Theory, it seeks to evaluate whether a condition or combination of conditions (conjunctural) is a consistent subset (sufficient for) of the phenomenon taken as the outcome set. More specifically, the aim is to identify combinations of education, sport (understood here as related to sports practice, encompassing the dimensions of sports education and participation[1]), unemployment, policing, poverty, income level, and population density, for both low and high rates of crime categories (Crimes Against Persons, Property Crime, Minor Offenses, and Drug Trafficking) in Minas Gerais municipalities. This identification is executed by one of CA's techniques, namely Qualitative Comparative Analysis (QCA).

The research hypothesis is that high rates of sport facilities and high school attendance, combined with other determining factors, configurationally imply low crime rates. Data from the Minas Gerais Social Responsibility Index (IMRS - *Índice Mineiro de Responsabilidade Social*) for the 853 municipalities of Minas Gerais, for the year 2016, are used. This year was chosen due to the availability of data for the variable used as a proxy for sport—municipal sport facilities. To identify the causal paths for different types of crimes in Minas Gerais municipalities, a fuzzy-set version of the Qualitative Comparative Analysis is employed.

High rates of sport facilities and high school attendance, conjuncturally with the other conditions, consistently proved relevant in the causal paths for “low rates of property crime,” “low rates of minor offense crime,” and “low rates of drug trafficking,” as conjectured; however, this was not the case for "low rates of crimes against persons."

The paper is structured as follows: after this introduction, a literature review on the economics of crime and a discussion on its relationship with sports and education are presented. This is followed by an explanation of the methodology and the data sources.

[1] Sport manifests itself through three dimensions: sport education, sport participation, and high-performance sport. For a deeper understanding of the social dimensions of sport, see Tubino (2001).

Finally, the empirical results are discussed, along with the conclusion regarding the research problem.

2. Literature Review

2.1. Crime, Education, and Sport

The economic analysis of crime is grounded in the concepts of negative externalities and diseconomies. Criminal behavior represents a significant subset of actions that cause harm to other members of society, highlighting the importance of restricting such activities (Becker, 1968). In a traditional microeconomic model, an individual decides to commit a crime if their expected utility is greater than the expected utility from other activities (Becker, 1968). The proposed model can be summarized as follows:

$$(1-p)U(f-c-m)-pU(s)>U(w) \quad (1)$$

Where: p is the probability of being apprehended, f is the financial gain from the illegal act, c is the cost of preparation and execution, m is the moral cost, s is the pecuniary loss from punishedment and w is the opportunity cost——wage in the formal market.

For a rational individual to decide to commit a crime, the expected value of the criminal remuneration less the expected value of the punishment (the left part of the equation) must exceed the opportunity cost associated with engaging in the offense (the right side of the equation).

Most evidence indicates that the elements of Becker's model indeed influence crime. Low wages or unemployment tend to diminish the positive incentives for legitimate activities and, comparatively, boost the—albeit risky—incentives for illegitimate activities. High crime rates are typically associated with elevated unemployment rates (Freeman, 1999).

A limitation of modeling along Becker's (1968) lines is the absence of social determinants acting as positive or negative incentives for entry into and persistence in illegal activities. For instance, sociological theories establish both economic and social dimensions, and social disorganization theory links crime to variables such as family structure, socioeconomic status, ethnic heterogeneity, residential mobility, and urbanization. Furthermore, individuals determine their behavior through personal experiences and interactions, social norms, and individual goals (Cerqueira and Lobão, 2004).

The impact of social events on crime rates can be more significant, especially among young people. This is because young individuals generally exhibit impulsive behavior, making crime more attractive as only present costs and immediate returns are considered (Gottfredson and Hirschi, 1990). In Brazil, De Mello and Schneider (2007) hypothesize that observed declines in crime rates might be attributable to a reduction in the youth population. Moreover, changes in young people's lives, such as lifestyle, behavior, and

socioeconomic conditions, can increase their exposure to crime, with incentives more strongly influenced by social vulnerability than by harsher punitive measures (Castro and Tirso, 2023).

Given the complexity associated with young people's entry into the illegal market, particularly the most vulnerable, it is relevant to analyze how public policies focusing on this social group—such as education and sports promotion initiatives—may relate to crime rates.

The interplay between crime and education is complex, given its susceptibility to education's effects on opportunities in both legal and illicit activities, personal risk preferences, and the social factors that shape individuals' lives. Furthermore, education can increase earnings in both legal and illegal markets (Ehrlich, 1975).

Violent and property crimes are typically linked to young people with low educational attainment, due to the low skill level involved and the low opportunity cost of entering the illicit market. Nonetheless, so-called "white-collar crimes" move in the opposite direction, as offenses offering higher returns for greater human capital are prone to be committed by individuals with higher levels of education and experience (Lochner, 2020; Lochner and Moretti, 2004).

Additionally, education can influence individuals' risk preferences, social ties, and group participation. The literature demonstrates, first, that the higher an individual's educational attainment, the greater their risk aversion. This is because individuals become more patient with increased time invested in education, which raises the opportunity cost of punishment. Second, keeping individuals in positive social circles can deter them from engaging in illegal activities influenced by negative networks, such as street gangs. Thus, schools play an important role in developing positive influence groups, especially for young people (Lochner, 2020).

Beyond being an important way to gain skills and knowledge, education can also help promote citizenship and spread core societal values. This creates a positive side effect that helps reduce crime (Usher, 1997).

Sports participation can generate a range of benefits for both individuals and society, including increased well-being and productivity, personal satisfaction, enhanced cognitive and non-cognitive skills, citizenship, social inclusion, improved physical and mental health, and the reduction of boredom and idle time (Downward *et al.*, 2009).

Sports hold significant potential to foster social integration and strengthen personal and community connections, aligning closely with the concept of social capital accumulation at both the individual and societal levels. However, for sports to be effective in crime prevention, it is essential that sporting activities promote positive social bonds and adhere to the values and best practices of sport (Nichols, 2004). To achieve this goal, it is important to acknowledge that sports participation is neither a uniform nor homogeneous experience.

Like education, sports can occupy idle time and steer individuals—especially youth—away from illicit activities. Juvenile crime is often linked to street gangs, as young people may join these groups to fulfill their need for approval, self-esteem, and a sense of

belonging. Thus, distancing youth from negative social environments is crucial to combating juvenile crime (Hartman and Depro, 2006).

Based on this understanding, it is believed that sports participation and access to education can negatively impact crime through four main mechanisms: (i) time occupation, (ii) increased moral cost, (iii) increased marginal disutility of punishment, and (iv) increased expected income. According to Ehrlich (1975), education—as well as sports—has an incapacitating effect by reducing the time available for other activities; in other words, while a person is at school or engaged in sports, they cannot commit crimes.

Sports and education may also influence how individuals assess the moral cost of criminal behavior. According to Usher (1997), education should not be seen solely as a means of acquiring skills, but also as a process of promoting citizenship and disseminating moral values. This notion can likewise be applied to sports, particularly when practiced within an educational context. In addition, education increases individuals' risk aversion (Lochner, 2020), thereby raising the marginal disutility of potential punishment.

Finally, it is well established that education can increase future returns in the legal labor market, thereby discouraging individuals from entering the illegal market. Sports participation, in turn, can enhance productivity—and thus future earnings—through improvements in physical and mental health, increased well-being, and the benefits of interpersonal interaction (Huang and Humphreys, 2012). It can also boost academic performance (Barron et al., 2000; Cornelißen and Pfeifer, 2007) and develop non-cognitive skills that reinforce cognitive abilities (Caruso, 2011), thereby amplifying the positive effects of education.

2.2. Empirical Studies

Several empirical studies aim to assess the statistical relationship between sports, education, and crime. However, they do not always approach education and sports jointly in relation to criminal behavior. Such an approach becomes particularly relevant when acknowledging the potential complementarity between these variables and their combined effects on crime.

The literature can be can be categorized into those that examine the relationship between crime and education, and those that investigate the link between crime and sports. In the first case, some studies use exogenous changes in education policy to assess the causal effect of education on crime. Lochner and Moretti (2004), for example, found robust causal evidence that education reduces criminal activity, based on changes in compulsory schooling laws. Machin *et al*. (2011) analyzed the education- crime relationship based on a legal reform that raised the minimum school leaving age in England and Wales, concluding that increased education led to a reduction in property crimes. Hjalmarsson *et al*. (2015) also found similar results following a compulsory education reform in Sweden; however, they did not find a significant causal effect for women, in contrast to the results observed for men. Machin *et al*. (2012) examined the relationship between education and crime through the expansion of education that took place in the United Kingdom between

the 1980s and 1990s. The authors concluded that increased education led to a reduction in juvenile crime, as well as in property and violent crimes. Buonanno and Leonida (2006) also support the idea that education contributes to the reduction of crime, based on evidence from Italian regions. Finally, Groot and Van Den Brink (2010) assessed the effects of education on crime using survey data collected from individuals over the age of 15 in the Netherlands. According to the authors, education may reduce both property and violent crimes; however, white-collar crimes—such as tax fraud—tend to increase with higher levels of education.

In Brazil, there are also studies that explore the relationship between education and crime. Teixeira (2011) examined the impact of school dropout rates on homicide rates across Brazilian states between 2001 and 2005, concluding that an increase in school dropout—understood as a decline in educational attainment—leads to higher homicide rates. Becker (2012) analyzed the effects of public spending on education on crime in Brazilian states. The author found that government spending in education helps reduce crime; however, a maturation period is needed before the effects of such investments become evident. Araújo Junior *et al.* (2012) investigated the determinants of juvenile crime among homeless children and adolescents in the city of Belo Horizonte, using survey data. The results highlighted the importance of access to education in reducing criminal behavior among the respondents.

The findings reported in the literature reviewed above converge in showing that education has a negative and causal relationship with various types of crime—with the exception of white-collar crimes, which, as proposed by Ehrlich (1975), tend to increase with higher educational attainment.

In contrast, studies examining sports as a determinant of crime yield mixed results and lack consensus on the nature of this relationship. Hartmann and Massoglia (2007) found that the effects vary depending on the type of offense: while sports participation may reduce shoplifting, it may also increase instances of drunk driving. In contrast, Vermillion (2007) concluded that there is a negative relationship between sports participation and delinquent behaviors. Mutz and Baur (2009) found no correlation between engagement in sports activities and a reduction in violence—an outcome also confirmed by Kreager (2007). However, Mutz and Baur did observe a positive association between participation in contact sports and involvement in physical fights. Begg *et al*. (1996) provide evidence that both women and men with high levels of sports activity were more likely to engage in delinquent behavior at the age of eighteen. Moreover, no relationship was found between sports participation and aggressive behavior, nor between participation in team sports and delinquent or aggressive conduct. Booth *et al.* (2008), however, found that sports involvement reduced delinquency only among females, while no significant relationship was observed for males.

Analyzing the impacts of the Midnight Basketball program on crime reduction in U.S. cities, Hartmann and Depro (2006) found that the implementation of the program was associated with a greater decrease in property crime rates compared to cities that did not adopt the program. Veliz and Shakib (2012) examined the relationship between sports

participation and delinquent behavior in U.S. public schools. Their study indicated that schools with higher involvement in sports activities reported fewer incidents of violent crimes and suspensions, although less violent crimes showed no association with sports participation. Brosnan (2020), analyzing the link between sports participation and crime in England—focusing on property and crimes against persons from 2012 to 2015—found that sports involvement had a stronger negative effect on reducing personal crimes than on property crimes in the period analyzed.

Caruso (2011) investigated the relationship between sports participation and criminal activity in Italy, concluding that engagement in sports activities reduces property crimes and juvenile delinquency, while the association between violent crimes and sports participation is positive but weakly significant. Moreover, the study revealed a complementary relationship between education and sports, evidenced by an interaction variable suggesting that the combination of these two factors may have a preventive effect on crime.

Finally, Roson *et al.* (2022), in a study of Brazilian municipalities between 2002 and 2010, found a negative correlation between crime rates and municipal sports involvement, using public spending on sports and leisure, along with variables measured from the sports institutional framework, as proxies. Additionally, their results indicate that this negative association is stronger for juvenile crime.

3. Methodology

3.1. Qualitative Comparative Analysis (QCA) Method

The complexity of the crime phenomenon, involving individual factors (psychological aspects), micro-environmental factors (family conditions, neighborhood characteristics, and localized policing), and macro-environmental factors (regional socioeconomic conditions, punishment structures, and judicial effectiveness), allows for the use of multiple research methods. Applying an approach that adequately addresses this complexity could generate useful insights for discussions on the type and scope of public criminal control policies, in terms of material and human resources, while considering the specific contextual features of the regions targeted by such policies.

The Configurational Approach was developed to analyze multivariate phenomena at the macrosocial level, allowing the comparative logic of small-N case-oriented research (macrosocial units) to be extended to larger samples, but under a concept of causality distinct from that underlying standard statistical techniques. In this approach, the phenomena being explained and explanatory factors are characterized as sets—referred to as the "outcome set" and "causal conditions," respectively—instead of variables; and the units of analysis (macrosocial units) are called cases. The assessment of empirical causality is based on the effect of qualitative changes (presence/absence) in the causal conditions on

the outcome[2]. That is, it investigates whether a qualitative variation in one or more causal conditions—or combinations thereof—produces a qualitative incremental effect on the outcome. It is important to note that, since it treats phenomena as sets, this approach employs set theory and Boolean logic.

Comparative Qualitative Analysis, also known as Configurational Comparative Method (Rihoux; Ragin, 2009), was introduced by Ragin (2014) and constitutes a family of techniques—*csQCA*, *mvQCA* and *fsQCA*—that differ according to the nature of the sets to which Boolean logic is applied[3]. In these techniques, causality is conjunctural and complex, consisting of three dimensions: (i) equifinality, referring to the presence of multiple combinations of causal conditions that lead to the same outcome; (ii) conjunctural causation, where causal conditions do not produce the outcome individually but in combination; and (iii) asymmetrical causality, meaning that the presence of the outcome requires a different analysis than its absence, since the presence and/or absence of isolated or combined causal conditions can lead to distinct outcomes (Betarelli and Ferreira, 2018). It should be noted that the idea of "relationship" in the QCA refers to the relationship between the result sets and causal conditions, and not to the correlation as in conventional statistical techniques (Ragin, 2006; 2014; Schneider and Wagemann, 2012)[4].

To illustrate, suppose the theoretical framework identifies four causal conditions—denoted by A, B, C, and D and operationalized as subsets of real numbers—that lead to an outcome Z, also represented as a subset of real numbers. Uppercase letters indicate the *presence* of a condition, while lowercase letters indicate its *absence*. If the QCA solution is expressed as "aBc + AcD → Z," this signifies two causal paths to Z. The logical combination "aBc," composed of the conditions "a" (absence of A) *and* "B" (presence of B) *and* "c" (absence of C), *or* (plus sign) the logical combination "AcD," composed of the conditions "A" (presence of A) *and* "c" (absence of C) *and* "D" (presence of D), implies the outcome "Z" (presence of Z). Empirical evidence from cases supports that either "absence of A, presence of B, and absence of C" or "presence of A, absence of C, and presence of D" leads to the outcome Z. It is important to note that the logical operators *and* and *or* correspond to set intersection and union, respectively. These configurations, "aBc" and "AcD," are referred to as causal paths toward Z.

This hypothetical example illustrates two defining features of complex causality—equifinality and conjunctural causation—since there are two conjunctural causal paths

[2] Presence/absence here refers to the empirical presence or absence of combinations of causal conditions and/or the outcome within the macrosocial unit of analysis (complex social formations such as societies, economies, or countries).

[3] For sets in which cases are differentiated only qualitatively and dichotomously (membership or non-membership in the set), *crisp-set QCA* (*csQCA*) or *multi-value QCA* (*mvQCA*) is applied; when, in addition to qualitative differences, there is a gradation of case membership in qualitative subsets, fuzzy-set *QCA* (*fsQCA*) is used.

[4] The terms "imply," "explain," and "cause" are synonymous with "consistent subset," and the term "causal relationship" refers to multiple conjunctural causation.

("aBc" and "AcD") leading to a single outcome, Z. If QCA were applied to identify the conditions or combinations of conditions for the absence of the outcome, "z," and the final solution was "bC + aCD → z," then, in addition to equifinality and conjunctural causation, the third dimension of complex causality—asymmetric causality—would also be present; thus, all dimensions would be covered in this QCA application.

These causal paths for the outcome are obtained through Boolean Minimization, a method that simplifies the initial combinations by reducing the sets of causal conditions to the outcome set, following this general rule: for any two original combinations of causal conditions leading to the outcome that differ in the qualitative value (presence/absence) of only one condition, that condition can be excluded, so the original combination becomes a simpler one. For example, if ABCd and ABcd are two primitive combinations relevant to the outcome Z, then condition C is redundant because both high "C" and low "c," intersected with the other conditions, imply Z. Therefore, this condition can be removed from the analysis, simplifying the relevant combinations to just ABd, which implies Z (Betarelli and Ferreira, 2018).

The condition combinations "aBc" and "AcD" are referred to as INUS conditions—Insufficient but Necessary parts of a condition that is itself unnecessary but sufficient for the outcome "Z." The condition "a" in the combination "aBc" is not sufficient on its own but is a necessary component of the combined condition "aBc," which by itself is not necessary but sufficient for "Z"; the same applies to conditions "B" and "c." Similarly, this reasoning applies to the individual conditions within "AcD." An analogous logic holds for the conditions "C" and "aCD" concerning the outcome "z."

Given the identified causal paths—"aBc" and "AcD" for "Z," and "bC" and "aCD" for "z"—it is essential to assess whether these paths are indeed consistent subsets of the outcome. In general, the "outcome set" can be determined by multiple combinations of causal conditions, which may or may not be necessary and/or sufficient for the outcome. A condition or combination of conditions is sufficient for an outcome if, whenever it is present, the outcome is also present. Conversely, a condition (or set of conditions) is necessary for the outcome if the outcome is present whenever the condition is present (Schneider and Wagemann, 2012; Betarelli and Ferreira, 2018).

It should be noted that QCA does not provide quantitative responses of the outcome set to variations in the magnitude of causal condition sets, as marginal effects are estimated in regression analysis; rather, it produces qualitative results based on qualitative variations (high or presence/low or absence) in combinations of causal conditions affecting the outcome set.

Although relatively incipient, applications of this approach in crime research have yielded promising results. More generally, Parker (2017) demonstrates the usefulness of the configurational approach in criminological research through an application of Crisp-Set QCA (with dichotomous causal conditions). More specifically, Miethe and Drass

(1999), distinguishing crimes into two classes—instrumental and expressive[5]—examined whether expressive homicides are similar to or specific to their social context (defined as combinations of characteristics of the offender, the victim, and the situation). Their QCA application showed that both classes of homicides are associated with common and specific conditions; however, most homicides involve combinations of individual and situational conditions. Regoeczi and Miethe (2003) examined the nature of homicides in terms of the "type of relationship between offender and victim" and changes in its structure over time. The application of QCA was justified by the intent to investigate whether "unknown relationship homicides" differ from "homicides involving other types of relationships (friendship, romantic ties, kinship, or even strangers)" in terms of complex combinations of attributes such as location, weapon type, and others.

In Brazil, although not focused specifically on the conjunctural causation of education on crime, Ferreira, Bastos, and Betarelli Jr. (2019) used "juvenile school dropout" and "adult school dropout" as causal conditions for high homicide rates (a proxy for criminality). However, only adult dropout proved consistent with high crime rates. In 2024, the same researchers applied fuzzy-set QCA to identify and explore the complex causation of policing levels and economic-sociodemographic disorganization on high homicide rates. Ferreira, Bastos, and Betarelli Jr. (2024) demonstrated, for Brazilian municipalities, that "high rates of family and personal disorganization" are necessary for "high homicide rates," whereas "high economic disorganization" and "demographic imbalance" are not necessarily so.

In this study, fuzzy-set theory is employed for defining the sets, including the outcome set, which conceives the characteristics of each case (the value taken in each set) as the degree of membership of the case in each set. This concept "transforms" the original characteristic value of each case in each set into a score within the real interval [0, 1] (Ragin, 2008; 2014). Scores closer to 1 indicate a higher degree of membership in the respective set, while scores closer to 0 indicate a lower degree of membership. When using the median (0.5) as a cutoff point—dividing scores into high and low subsets—scores above 0.5 classify the case as mostly "in" the set, whereas scores below 0.5 classify it as mostly "out" of the set (Ragin, 2006). In essence, the transformation ranks original case values into fuzzy membership scores ranging from 0 to 1.

Once variables are transformed into fuzzy sets, scores must be calibrated by defining qualitative anchors for each set, which allow distinguishing cases with stronger and weaker membership within the calibrated set. The selection of qualitative anchors relies on established calibrations in the applied QCA literature and on empirical knowledge of the cases themselves (Schneider and Wagemann, 2012). In the absence of prior information necessitating adjustment, standard anchors are maintained for each fuzzy set—the minimum, median, and maximum (0; 0.5; 1).

[5] Instrumental crimes are committed with explicit future goals (e.g., to obtain money or improve social status), whereas expressive crimes arise from unplanned acts (anger or frustration).

Final configurations (i.e., relevant causal paths) for the outcome are extracted from the Truth Table, which contains: the list of all possible logical combinations of causal conditions (consisting of primitive or complex combinations); the distribution of cases across these combinations; and the consistency measures of these combinations in relation to the outcome. Prior to Boolean minimization, the cutoff criteria by Olsen and Nomura (2009) are applied: identification of the most relevant complex combinations in terms of representativeness—according to Ragin (2008), these are combinations that cover between 75% and 80% of the total number of cases; selection of complex combinations that are consistent with the outcome—to measure the extent to which cases share the complex combination with the outcome; and comparison of the consistency and coverage measures of the causal paths to select the final solution. The first two criteria are applied during the Truth Table analysis stage, while the last is applied after Boolean minimization. Final solutions are the most relevant consistent combinations for the outcome. They reduce the initial causal condition configurations depending on three types of solutions: complex, parsimonious, and intermediate. The complex solution treats logical remainders (combinations with zero frequency of cases) as nonexistent; the parsimonious solution uses logical remainders to find the simplest possible solution; the intermediate solution considers only easy-type[6] logical remainders and is the most commonly used in QCA applications (Betarelli and Ferreira, 2018). Thus, the intermediate solution was adopted in this application.

The main validation criteria in QCA are the consistency and coverage measures—descriptive metrics of the degree of proximity between sets that assess how much the cases in a given condition (or combination of conditions) overlap with the outcome set (Ragin, 2006). Consistency relates to the assessment of sufficiency, while coverage relates to necessity. Consistency measures the degree to which each solution and each solution term[7] is a subset of the "outcome set." It indicates that whenever the causal path is present in the macro-social unit, the outcome is also present—and the closer the score is to 1, the greater the consistency of the data. Coverage, on the other hand, quantifies the empirical importance of each solution term for the outcome, revealing the proportion of the outcome set that is explained by the final solution and by each individual solution term (Ragin, 2006). The higher the coverage, the greater the empirical relevance of the specific configuration for the outcome.

From this perspective, this article presents a QCA application aimed at identifying the conjunctural causation of sports and education for both low and high levels of four categories of crime across the macro-social units "municipalities of Minas Gerais": violent property crime, violent crime against persons, minor offenses, and drug trafficking. The selection criteria for complex combinations subjected to Boolean minimization were:

[6] A logical remainder is considered "easy" when the researcher has information about the relationship between the conditions and the outcome. This information can be used in the analysis to determine whether the logical remainder combination is a consistent subset of the outcome.

[7] A solution term refers to the condition or combination of conditions that constitutes a consistent causal path.

combinations accounting for at least 40% of the cases and exhibiting a consistency level above 0.8. Fuzzy sets were constructed using *Stata 15* (StataCorp, 2017). Truth tables and Boolean minimizations were performed using *fsQCA 3.0* (Ragin, 2018), which produced the final solutions for each crime type. In all cases, the analysis focused on causal paths associated with both low and high levels of crime.

3.2. Database

This study relies on data from the Minas Gerais Social Responsibility Index (IMRS – *Índice Mineiro de Responsabilidade Social*) for all 853 municipalities in the state of Minas Gerais for the year 2016 (Table 1). The IMRS database consolidates information from various national and local primary research sources. Data on crime and policing were obtained from records of the Military and Civil Police, made available by the Public Security Observatory of the state of Minas Gerais (SEJUSP – *Secretaria de Estado de Justiça e Segurança Pública*). Education data come from the School Census, conducted by the National Institute for Educational Studies and Research Anísio Teixeira (INEP – *Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira*), and sports data were sourced from the Survey of Basic Municipal Information (MUNIC – *Pesquisa de Informações Básicas Municipais*), conducted by the Brazilian Institute of Geography and Statistics (IBGE – *Instituto Brasileiro de Geografia e Estatística*). Finally, additional data were obtained from the Unified Registry for Social Programs (CadÚnico – *Cadastro Único para Programas Sociais*) and the IBGE.

The state of Minas Gerais was selected as the object of study due to the availability and quality of data on specific types of crime. The inclusion of other states was deemed unfeasible, primarily for two reasons: (i) few states make data from both Military and Civil Police publicly available; and (ii) even among those that do, there is no standardization in data collection or crime classification.

The year 2016 was chosen for the analysis because it corresponds to the most recent survey on the number of municipal sports facilities, which is used to construct the proxy variable for sports—defined as the ratio of municipal sports facilities per 100,000 inhabitants. This data was collected by the 2016 edition of the MUNIC survey, which gathered information from municipal governments on local sports infrastructure, representing the latest municipal-level data available on the topic.

As outcome sets, four crime categories—recorded by the state police—were employed: (i) **Violent property crime (C)**: the ratio between the total number of reported violent property crimes (robbery and extortion through abduction, completed) and the municipality's population, multiplied by 100,000; (ii) **Violent crime against persons (H)**: the ratio between the total number of reported violent crimes against persons (homicide, rape, and statutory rape, whether completed or attempted) and the municipality's population, multiplied by 100,000; (iii) **Minor offenses (M)**: the ratio between the total number of reported minor offenses (theft and drug use/possession) and the municipality's

population, multiplied by 100,000; and (iv) **Drug trafficking (T)**: the ratio between the total number of reported drug trafficking cases and the municipality's population, multiplied by 100,000.

As a causal condition, education is proxied by **High School Net Enrollment Rate (E)**, defined as the ratio between the number of individuals aged 15 to 17 enrolled in upper secondary school and the total population in that age group residing in the municipality, multiplied by 100. The variable was used by Gomes *et al.* (2017) and Ervilha and Lima (2019) in studies on crime in Minas Gerais. It is expected to capture not only the accumulation of human capital within the municipality but also, more importantly, the incapacitation effects and the promotion of positive social networks provided by school environments for young people.

Table 1 – Variable Descriptions

Variable	Description	Source
Violent Property Crime	Ratio of total reported cases of violent property crimes (robbery and completed extortion through abduction) registered by state police forces to the municipal population, multiplied by 100,000.	SEJUSP
Violent Crime Against Persons	Ratio of total reported cases of violent crimes against persons (homicide, rape, and statutory rape—completed or attempted) registered by state police forces to the municipal population, multiplied by 100,000.	SEJUSP
Minor Offenses	Ratio of total reported cases of minor offenses (theft and drug use or possession) registered by state police forces to the municipal population, multiplied by 100,000.	SEJUSP
Drug Trafficking	Ratio of total reported drug trafficking cases registered by state police forces to the municipal population, multiplied by 100,000.	SEJUSP
Population Density	Ratio of the municipality's total resident population to its total area.	IBGE
GDP	Value of the municipality's Gross Domestic Product divided by its population.	IBGE
Poverty	Ratio of the total number of individuals classified as poor or extremely poor, according to Ministry of Citizenship criteria and registered in the CadÚnico, to the total municipal population.	CadÚnico
Unemployment	Ratio of the working-age population (18 to 64 years old) registered in the CadÚnico without employment to the total working-age population registered in the CadÚnico.	CadÚnico
Police	Ratio of the total number of police officers (military and civil) to the municipal population, multiplied by 100,000.	SEJUSP

Education	High School Net Enrollment Rate: ratio of individuals aged 15 to 17 enrolled in high school to the total population in that age group residing in the municipality, multiplied by 100.	INEP
Sports	Ratio of the total number of municipal sports facilities to the municipal population, multiplied by 100,000.	IBGE

Source: own elaboration based on the information available in the IMRS.

To assess sports, the **Sports Facilities (S)** rate is employed. This is defined as the ratio of the total number of municipal sports facilities to the municipal population, multiplied by 100,000. The underlying assumption is that a higher number of sports facilities corresponds to greater sports participation within the city. This assumption is based on two main points: (i) engaging in sports requires adequate infrastructure, and a higher concentration of facilities encourages physical activity; and (ii) a large number of facilities reflects stronger municipal commitment to promoting sports—not only through the provision of physical spaces but also through programs and initiatives that foster athletic participation.

In addition, socioeconomic variables that are theoretically and empirically related to crime are included in the analysis. **Population Density (U)** is frequently used as a proxy for opportunity cost, since population concentration not only increases the number of potential victims available to offenders, but also lowers the likelihood of apprehension (Ehrlich, 1975).

Municipal GDP (Y) has both positive and negative associations with crime. On the one hand, greater economic activity means more opportunities in the formal labor market, thus increasing the opportunity cost of entering the illegal market. On the other hand, it may increase the expected returns from criminal activity, since potential victims may possess greater economic resources (Becker, 2012; Teixeira, 2011; Gomes et al., 2017; Ervilha and Lima, 2019).

Poverty (V) and **Unemployment (D)** also exhibit a dual relationship with crime. High crime rates are associated with both high poverty and high unemployment, due to the low opportunity cost of engaging in crime given the scarcity of legal employment opportunities, and with low poverty and low unemployment, due to a smaller number of "profitable" potential victims. Additionally, these variables relate to social disorganization, which in turn may drive higher levels of crime (Freeman, 1999; Cerqueira and Lobão, 2004).

According to Becker (1968), there is a negative relationship between the probability of apprehension and crime. Brazilian authors such as Becker (2012) and Teixeira (2011) use public security expenditures as a proxy for this variable. However, since the analysis is at the municipal level, and in Brazil public security is the responsibility of the State Government, the proxy used is the number of military and civil police officers per one hundred thousand inhabitants—**Police (P)**.

Table 1 presents descriptive statistics of the variables used in the estimations. It is worth noting that the variables include 853 observations, consistent with the number of municipalities in the state, except for the sports facilities rate. This exception is due to ten municipalities not responding to the MUNIC survey (missing values), and thus being excluded from the estimations.

On average, 176 violent property crimes, 53 violent crimes against persons, 1,204 minor offenses, and 75 drug trafficking incidents per 100,000 inhabitants were recorded in municipalities in Minas Gerais in 2016. However, crime rates are not homogeneous, as evidenced by the high standard deviations. For instance, 68 municipalities reported no violent property crimes, 106 recorded no violent crimes against persons, and 133 had no drug trafficking incidents. In contrast, Contagem, Belo Horizonte, and Nova Serrana registered the highest rates of violent property crime—2,124, 1,885, and 1,884 per 100,000 inhabitants, respectively.

Table 1 – Descriptive Statistics

Variable	Obs.	Mean	SD	Min	Max
Violent property crime	853	176	246	0	2124
Violent crime against persons	853	53	44	0	300
Minor offenses	853	1204	2195	25	62730
Drug trafficking	853	75	156	0	4197
Sports facilities	843	67	57	1	496
Education	853	0.90	0.09	0.36	1.00
Police	853	146	85	19	680
Density	853	69	333	1	7533
Poverty	853	0.04	0.02	0.01	0.26
Unemployment	853	0.04	0.02	0.00	0.18
Per capita GDP	853	17989	15970	5447	183218
Population	853	24361	99036	807	2487450

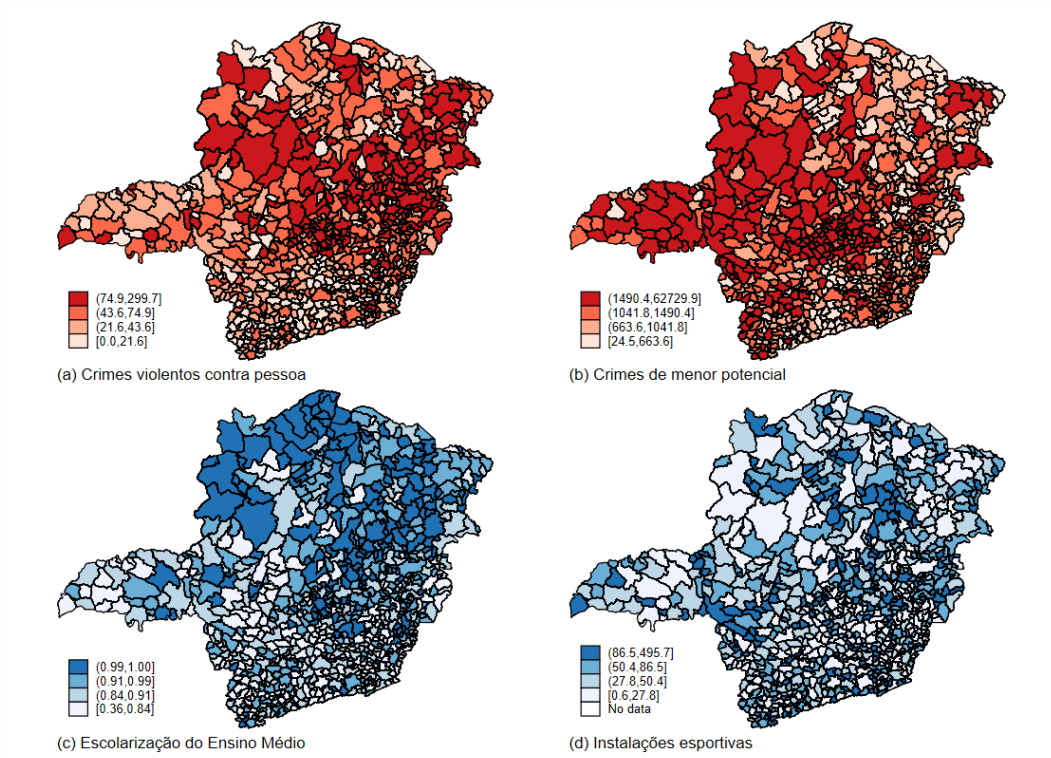
[a] Violent property crime, Violent crime against persons, Minor offenses, Drug trafficking, Sports facilities, and Police are expressed per 100,000 inhabitants. Education corresponds to the percentage rate of youths aged 15 to 17 enrolled in high school relative to the total population of the same age group. Poverty and Unemployment rates are the percentages of the total poor population and unemployed working-age population, respectively, relative to their respective totals. Density is the ratio between the population and the total area of the municipality. Per capita GDP is the total GDP divided by the number of inhabitants.
[b] Values are rounded, with two decimal places shown only for percentage rate variables.
Source: own elaboration based on Stata 15 software and data from SEJUSP, IBGE, INEP, and CadÚnico for the year 2016.

Municipalities in Minas Gerais have, on average, 67 sports facilities per 100,000 inhabitants, although there is considerable variation. For example, Contagem and Ribeirão

das Neves—cities with high crime rates—have fewer than one facility per 100,000 people, while Serra da Saudade has nearly 500 facilities per 100,000 inhabitants. Furthermore, the average high school net enrollment rate is 89.8%, exhibiting less variation than the crimes and sports variables. Nevertheless, while Santa Cruz de Minas reports an enrollment rate of 36%, 202 municipalities have full (100%) enrollment in high school.

Figure 1 displays the spatial distribution of violent crime rates against persons, minor offenses, and sports facilities per 100,000 inhabitants, and the high school net enrollment rate. The distribution of sports facilities is fairly uniform across the state, showing no clear spatial pattern, whereas enrollment rates tend to be higher in the northern region. Violent crimes against persons are more prevalent in the Central, Metropolitan, Northwest, and Jequitinhonha/Mucuri regions. The latter two exhibit spatial patterns of higher education rates, unlike the former two. In turn, minor offenses are more concentrated in the Triângulo, Central, Metropolitan, and Northwest regions. With the exception of the Northwest, these regions do not show an apparent concentration of high rates of educational attainment or sports facilities.

Figure 1 – Spatial distribution maps of crime rates, sports facilities, and high school enrollment



[a] Violent crimes against persons and minor crimes are calculated by dividing the total number of occurrences by the total population and multiplying by 100,000. High school enrollment rate is the ratio of youths aged 15 to 17 enrolled in high school to the total population in the same age group, multiplied by 100. Sports facilities rate is the ratio of total municipal sports facilities to the municipality's population, multiplied by 100,000.
Source: own elaboration based on Stata 15 software and data from SEJUSP, IBGE, and INEP for the year 2016.

4. Results

This study aims to identify consistent combinations of causal conditions that lead to either low or high crime rates, regardless of the crime category. Thus, the causal paths leading to high/low crime are presented, with the expectation that the relationships involving sports and/or education are inverse. In order to present only the most relevant cases for each outcome set, only final configurations with at least 40% coverage and 0.8 consistency are selected. In cases where no configuration reaches coverage above 40%, the paths closest to this threshold are shown.

Table 2 summarizes the most relevant consistent paths for each of the four crime categories. For instance, the causal path "uVDES + yVDp + yVDs" (with solution terms "uVDES" or "yVDp" or "yVDs") implies a "low rate of violent crimes against property";

a similar interpretation applies to each of the other causal paths, including those indicating high crime rates. Three crime categories show that low crime rates are associated with the same set of three distinct causal conditions. Only violent crime against persons presents a different final causal configuration.

For "low violent crime against property" (c), "low minor offense crime" (m), and "low drug trafficking" (t), the causal path "low population density, high poverty, high unemployment, high education, and high sports facilities" (uVDES) stands out. This finding offers empirical support for the hypothesis that high levels of sports infrastructure and secondary school enrollment may jointly contribute to reducing crime rates.

Notably, "high sports facilities (S) and high education (E)" emerge as conjuncturally sufficient for "low crime" when combined with "high poverty (V), high unemployment (D), and low population density (P)". Municipalities characterized by the "uVDES" path for low rates of violent property crime, minor offenses, and drug trafficking tend to have an average population density of 12.09 inhabitants per km², significantly below the state average of 69.99, and an average municipal GDP of approximately R$11.2 million, roughly 60% of the state average of R$18 million.

It is worth noting that the other two solution terms, "yVDp" and "yVDs", within the consistent causal path "uVDES + yVDs + yVDp"—which differ only in the fourth causal condition ("p" or "s")—are also relevant for explaining "low violent property crime", "low minor offenses", and "low drug trafficking". Interestingly, the condition "low sports facilities" appears conjuncturally associated with the combination of "low GDP, high poverty, and high unemployment, implying lower crime rates. At first glance, this seems to contradict the initial hypothesis. However, the presence of low sports infrastructure does not include any specific pattern regarding education levels, and is observed alongside low GDP, high poverty, and high unemployment. Although the presence of limited sports infrastructure in this configuration seems to produce effects contrary to expectations, Mutz and Baur (2009), for instance, found a positive relationship between aggressive behavior and participation in contact sports. A possible explanation for this outcome is that the types of sports practiced in these facilities may not align with best practices in sports, thereby producing unintended or adverse effects.

Table 2 – QCA Results

Outcome	Crime Category	Conditions[a]	Coverage	Consistency
Low	Violent Property Crime	yVDs	0.418	0.832
		yVDp	0.493	0.846
		uVDES	0.406	0.909
	Violent Crime Against Persons	Uvde	0.445	0.852
		Yvde	0.477	0.825
		YvdP	0.461	0.811
		vdPS	0.415	0.846

	Minor Offenses	yVDs	0.435	0.857
		yVDp	0.526	0.895
		uVDES	0.401	0.891
	Drug Trafficking	yVDs	0.423	0.844
		yVDp	0.515	0.888
		uVDES	0.409	0.920
High	Violent Property Crime	UYvds	0.412	0.855
		Yvdes	0.390	0.851
		UYvdP	0.391	0.845
	Violent Crime Against Persons	yVDpS	0.381	0.811
		uVDES	0.374	0.823
		yVDpE	0.379	0.810
	Minor Offenses	Uvde	0.436	0.827
		Yvde	0.491	0.844
		YvdP	0.499	0.870
		vdPS	0.411	0.832
		UYvds	0.426	0.889
	Drug Trafficking	Uvde	0.452	0.848
		Yvde	0.496	0.842
		YvdP	0.494	0.851
		UYvds	0.440	0.909

[a] The causal conditions are represented by the following sets: E (Education), S (Sports Facilities Rate), U (Population Density), Y (GDP), V (Poverty), D (Unemployment), and P (Police). Uppercase letters indicate high set membership, while lowercase letters indicate low membership.
Source: own elaboration based on the FsQCA software (Ragin, 2018).

The outcome of low violent crime against persons presents consistent configurations that differ from those observed for other types of crime. This divergence can be explained by the distinct nature of such offenses, which tend to be driven more by emotional or impulsive motivations than by rational calculations, and are therefore harder to explain through economic theories of individual decision-making.

For violent crimes against persons, sports appear in only one consistent configuration (vdPS), where high access to sports facilities is combined with high police presence and low poverty and unemployment. This suggests that the availability of spaces for sports practice may help reduce crimes against persons—particularly when combined with increased policing and in economically developed municipalities. Although based on a different methodology, this result aligns with findings from Veliz and Shakib (2012) and Brosnan (2020), who reported a negative association between sports participation and crimes against persons.

Education appears in two consistent configurations (Uvde and Yvde); however, in both cases, low education levels are associated with low crime rates. An analysis of these two configurations shows that they are linked to low poverty and unemployment, with one associated with high GDP per capita and the other with high population density. In larger and more economically developed municipalities, although education may still form part of a broader crime prevention strategy, its conjunctural effect appears to be less significant than that of variables such as police presence.

When analyzing the solutions for the "high crime" outcome, one observes a key difference from the previously discussed configurations: distinct consistent paths imply distinct crime outcomes. Moreover, the causal conditions "sports" and "education" combine with the other variables in different ways depending on the crime category under analysis.

As with the "low-crime" results, "high violent crime against persons" is associated with unique combinations of causal conditions. Three consistent configurations involve sports and/or education in relation to the outcome "high violent crime against persons": yVDpS, yVDpE, and uVDES. It is worth noting that the configuration uVDES is the same one that implies "low crime (against property, minor offenses, and drug trafficking)". However, it is a less relevant path in this case, given its lower coverage and consistency scores.

For the outcome high violent property crime, education and sports appear in two consistent combinations (Yvdes and UYvds). In the first, both sport and education appear in their "low" configuration, as expected. Additionally, they are associated with high GDP, poverty, and unemployment. In other words, in economically developed municipalities, low levels of education and sports participation may lead to high property crime. In the second configuration, sport is not accompanied by the condition of education. Still, sport shows an inverse association with high violent property crime, similar to findings by Caruso (2011) and Brosnan (2020), who used econometric approaches.

In the case of high drug trafficking, both education and sport appear in three consistent paths (Uvde, Yvds, and UYvds), though always separately. Thus, the hypothesis that both sport and education are inversely related to crime is reinforced; lower levels of sport or education may be associated with high crime even when not jointly present.

Finally, for the outcome "high minor offense crime," the condition "low education" appears in two paths—Uvde and Yvde. "Low sports" also appears in two consistent, but distinct, configurations—it is "high" in the path vdPS and "low" in UYvds. The second path resembles the solution for other crime categories, except for "high violent crime against persons," and aligns with theoretical expectations. Regarding the vdPS configuration, it is worth highlighting that "high sport" is associated with "high policing (number of police officers per 100,000 inhabitants)." Moreover, the conditions "high or low GDP and population density" do not appear in this configuration, indicating that they are not relevant for this particular outcome.

4. Conclusion

This study aims to identify the complex causal relationships underlying high and low crime rates in the municipalities of Minas Gerais, using public security (SEJUSP), educational (INEP), sports infrastructure and demographic (IBGE), and social vulnerability (CadÚnico) data from 2016. More specifically, it investigates how sports and education are associated with four aggregated crime measures. The core premise is that these conditions, especially when combined, may help mitigate local crime by discouraging participation in the illegal market, particularly among youth.

The study employs Qualitative Comparative Analysis, a method that enables the examination of complex conjunctural causality and, unlike econometric analysis, assesses whether specific combinations of conditions are empirically sufficient to explain different crime categories. The configurational approach is particularly relevant given the multifaceted nature of criminal phenomena and their multiple causes, thus complementing the existing empirical literature. Furthermore, the QCA results provide valuable insights for the discussion of integrated regional public security policies.

The results for low crime rates (property crime, minor offenses, and drug trafficking) show that one causal path (uVDES) involves sports and education acting jointly. For high crime rates, sports and education simultaneously compose the causal path (Yvdes) only for property crime. In other categories (except violent crimes against persons), these factors appear separately and, in most consistent paths, are associated inversely with crime rates. These findings support the hypothesis that education and sports are causal conditions that inversely affect different crime outcomes (high or low).

Thus, a possible approach to crime reduction (except for violent crimes against persons) would be a public policy promoting sports participation combined with education, particularly in smaller municipalities. The most relevant solution term for the causal path to low rates of property crime, minor offenses, and drug trafficking suggests important implications for juvenile crime control policies in small municipalities. These municipalities are characterized by high poverty and unemployment (indicating low employment opportunities) and low municipal GDP. Policy discussions could therefore focus on the role of sports facilities and activities, as well as monitoring school attendance rates and other youth educational performance indicators. Such measures could serve as minimum social indicators, potentially signaling municipal levels of property crimes, minor offenses, and drug trafficking.

The strategy employed provides empirical evidence from a configurational perspective, as this methodological approach allows for the identification of causal paths for outcome sets by analyzing how education and sports, either alone or combined with other determinants, form different configurations that explain the same phenomenon. This can assist policymakers in developing varied public policy strategies to reduce crime. Thus, the approach proves relevant, since the conditioning factors exhibit complementary effects on crime, distinguishing it from traditional empirical approaches. However, QCA does not enable quantitative measurement of the relationship or the magnitude of the

complementarity effect between the conditioning factors (education and sports), representing an opportunity for future research.

References

ARAÚJO JUNIOR, A. F.; SHIKIDA, C. D.; NOGUEIRA, Reginaldo Pinto; FERREIRA, Frederico M. Poley (2012), "Socio-economic determinants of juvenile crime among street children and teenagers in a Brazilian state", **Economics Bulletin**, 32 (3), Tampa, Economics Bulletin Publishing Company, pp. 2076-2084.

ATLAS DA VIOLÊNCIA. In: Intituto de Pesquisa Economica Aplicada (IPEA), 2023. Disponível em: https://www.ipea.gov.br/atlasviolencia/. Acesso em 11 dez. 2023.

BARRON, John M.; EWING, Bradley T.; WADDELL, Glen R (2000). The effects of high school athletic participation on education and labor market outcomes. **Review of Economics and Statistics**, v. 82, n. 3, p. 409-421.

BECKER, G. S. (1968), "Crime and punishment: An economic approach", **Journal of political economy**, 76 (2), Chicago, University of Chicago Press, pp. 13-68.

BECKER, K. L. (2012), "Uma análise econômica da relação entre a educação e a violência", tese de doutorado, Universidade de São Paulo, São Paulo.

BEGG, D. J.; LANGLEY, J. D.; MOFFITT, T.; MARSHAL, S. W. (1996), "Sport and delinquency: an examination of the deterrence hypothesis in a longitudinal study", **British journal of sports medicine**, 30 (4), Loughborough, British Medical Journal, pp. 335-341.

BETARELLI, A. A.; FERREIRA, S. F. (2018), **Introdução à análise qualitativa comparativa e aos conjuntos Fuzzy**. Brasília, Escola Nacional de Administração Pública.

BOOTH, J. A.; FARRELL, A.; VARANO, S. P. (2008), "Social control, serious delinquency, and risky behavior: a gendered analysis", **Crime & Delinquency**, 54 (3), Thousand Oaks, SAGE Publications, pp. 423-456.

BROSNAN, S. (2020), "The impact of sports participation on crime in England between 2012 and 2015" **Sport in Society**, 23 (6), Oxfordshire, Taylor & Francis, pp. 1080-1090.

BUONANNO, P.; LEONIDA, L. (2006), "Education and crime: evidence from Italian regions", **Applied Economics Letters**, 13 (11), Oxfordshire, Taylor & Francis, pp. 709-713.

CARUSO, R. (2011), "Crime and sport participation: Evidence from Italian regions over the period 1997–2003", **The Journal of Socio-Economics**, 40 (5), Amsterdã, Elsevier, pp. 455-463.

CASTRO, M.; TIRSO, C. (2023). "The impacts of the age of majority on the exposure to violent crimes", **Empirical Economics**, Springer, vol. 64(2), pages 983-1023, February.

CERQUEIRA, D.; LOBÃO, W. (2004), "Determinantes da criminalidade: arcabouços teóricos e resultados empíricos", **Dados**, 47 (2), Rio de Janeiro, IESP-UERJ.

CORNELIßEN, Thomas; PFEIFER, Christian (2007). The impact of participation in sports on educational attainment. New evidence from Germany. **SOEPpapers**, n. 68.

DE MELLO, J.M.P.; SCHNEIDER, A. (2007). Mudança demográfica e a dinâmica dos homicídios no Estado de São Paulo. **São Paulo em Perspectiva**, v. 21, n. 1, p. 19-30.

DOWNWARD, P.; DAWSON, A.; DEJONGHE, T. (2009), **Sports economics: Theory, evidence and policy**, Oxford, Routledge.

EHRLICH, I. (1975), "On the relation between education and crime", in Thomas Juster, (ed.) **Education, income, and human behavior**, Cambridge, NBER, pp. 313-338.

ERVILHA, G. T.; LIMA, J. E. (2019), "Um método econométrico na identificação dos determinantes da criminalidade municipal: a aplicação em Minas Gerais, Brasil (2000-2014)", **Economía, sociedad y territorio**, 19 (59), Zinacantepec, El Colegio Mexiquense, pp. 1059-1086, doi: https://doi.org/10.22136/est20191250.

FERREIRA, S. F.; BASTOS, S. Q. A.; BETARELLI JR, A. A. (2019). The role of social control in Brazilian homicide rates. **Quality & Quantity**: International Journal of Methodology, Springer, vol. 53(6), pp 2695-2717.

FERREIRA, S. F.; BASTOS, S. Q. A.; BETARELLI JR, A. A. (2024). Configurações de policiamento e desorganização econômica-sociodemográfica para alta taxa de homicídio: Brasil e macrorregiões (1991-2010). *Ciências Sociais Em Revista*, *60*(1). https://doi.org/10.34024/csr.2024.60.1.17502

FREEMAN, R. B. (1999), "The economics of crime", in Orley C. Ashenfelter e David Card (eds.), **Handbook of labor economics**, vol. 3, Amsterdã, Elsevier, pp. 3529-3571.

GOMES, C. E.; EVANGELISTA, T. F.; LIMA, R. L.; PARRÉ, J. L. (2017), "Determinantes do crime nos municípios de Minas Gerais e seus possíveis spillovers espaciais", **Revista Economia Ensaios**, 31 (2), Uberlândia, UFU, pp. 201-228.

GOTTFREDSON, Michael R.; HIRSCHI, Travis (1990). A general theory of crime. In: A general theory of crime. **Stanford University Press**.

GROOT, W.; VAN DEN BRINK, H. M. (2010), "The effects of education on crime", **Applied Economics**, 42 (3), Londres, Taylor & Francis, pp. 279-289.

HARTMANN, D.; DEPRO, B. (2006), "Rethinking sports-based community crime prevention: A preliminary analysis of the relationship between midnight basketball and urban crime rates", **Journal of sport and social issues**, 30 (2), Thousand Oaks, Sage Publications, pp. 180-196.

HARTMANN, D.; MASSOGLIA, M. (2007), "Reassessing the relationship between high school sports participation and deviance: Evidence of enduring, bifurcated effects", **The Sociological Quarterly**, 48 (3), Cedar Falls, University of Northern Iowa, pp. 485-505.

HJALMARSSON, R.; HOLMLUND, H.; LINDQUIST, M. J. (2015), "The Effect of Education on Criminal Convictions and Incarceration: Causal Evidence from Micro-data", **The Economic Journal**, 125 (587), Londres, Oxford University Press, pp. 1290-1326, doi: https://doi.org/10.1111/ecoj.12204

HUANG, Haifang; HUMPHREYS, Brad R (2012). Sports participation and happiness: evidence from US microdata. **Journal of Economic Psychology**, v. 33, n. 4, p. 776-793.

KREAGER, D. A. (2007), "Unnecessary roughness? School sports, peer networks, and male adolescent violence", **American sociological review**, 72 (5), Washington, American Sociological Association, pp. 705-724.

LOCHNER, L. J. (2020), "Education and crime", in Steve Bradley e Colin Green (eds.), **The economics of education** (Second Edition), vol. 2, Amsterdã, Academic Press, pp. 109-117.

LOCHNER, L. J.; MORETTI, E. (2004), "The effect of education on crime: Evidence from prison inmates, arrests, and self-reports", **American economic review**, 94 (1), Nashville, American Economic Association, pp. 155-189.

MACHIN, S.; MARIE, O.; VUJIĆ, S. (2011), "The crime reducing effect of education", **The Economic Journal**, 121 (552), Londres, Royal Economic Society, pp. 463-484, doi: https://doi.org/10.1111/j.1468-0297.2011.02430.x

MACHIN, S.; MARIE, O.; VUJIĆ, S. (2012), "Youth crime and education expansion", **German Economic Review**, 13 (4), Berlim, Verein für Socialpolitik, pp. 366-384.

MIETHE, T. D.; DRASS, K. A. Exploring the social context of instrumental and expressive homicides: an application of qualitative comparative analysis. **Journal of Quantitative Criminology**, v. 15, n. 1, p. 1-21, 1999.

MUTZ, M.; BAUR, J. (2009), "The role of sports for violence prevention: sport club participation and violent behaviour among adolescents", **International journal of sport policy**, 1 (3), Londres, Taylor & Francis, pp. 305-321.

NICHOLS, G. (2004), "Crime and punishment and sports development", **Leisure Studies**, 23 (2), Londres, Taylor & Francis, pp. 177-194.

OLSEN, W., NOMURA, H. (2009), Poverty reduction – fuzzy sets *vs.* crisp sets compared. *Sociological Theory and Method*, **24**(2):219-246.

PARKER, B. L. (2017). Crisp-set Qualitative Comparative Analysis (csQCA) and Criminology. **Journal of Qualitative Criminal Justice & Criminology**. https://doi.org/10.21428/88de04a1.e9eca896

RAGIN, C. C. (2018), **User's Guide to Fuzzy-Set/Qualitative Comparative Analysis (fsQCA) 3.0**. Irvine, Department of Sociology of University of California.

RAGIN, C. C. (2014), **The comparative method: Moving beyond qualitative and quantitative strategies,** Oakland, University of California Press.

RAGIN, C. C. (2008), **User's guide to fuzzy-set/qualitative comparative analysis**, Tucson, University of Arizona.

RAGIN, C. C. (2006), "Set relations in social research: Evaluating their consistency and coverage", **Political analysis**, 13 (3), Cambridge, Cambridge University Press, pp. 291-310.

REGOECZI, W. C.; MIETHE, T. D. Taking on the unknown: A qualitative comparative analysis of unknown relationship homicides. **Homicide Studies**, v. 7, n. 3, p. 211-34, 2003.

Rihoux, B., & Ragin, C. C. (2009). **Configurational comparative methods: Qualitative comparative analysis (QCA) and related techniques**. Sage Publications. Disponível em: https://doi.org/10.4135/9781452226569. Acesso em: 30 jun. 2024.

ROSON, I. O. S.; BASTOS, S. Q. A.; ALMEIDA, E. S.; FERREIRA, S. F. (2022), "Esporte e prevenção criminal: uma análise dos municípios brasileiros para 2002 e 2010", **Economia e Sociedade**, v. 31, n. 2 (75), Campinas, Unicamp, p. 515-545.

SCHNEIDER, C. Q.; WAGEMANN, C. (2012), **Set-theoretic methods for the social sciences: A guide to qualitative comparative analysis**, Cambridge, Cambridge University Press.

STATACORP (2017). **Stata Statistical Software: Release 15**, College Station, TX: StataCorp LLC.

TEIXEIRA, E. C. (2011), "Dois ensaios acerca da relação entre criminalidade e educação", tese de doutorado, Universidade de São Paulo, São Paulo.

TUBINO, Manoel José Gomes (2001), **Dimensões sociais do esporte**. 2ª ed., São Paulo: Cortez Editora.

USHER, D. (1997), "Education as a Deterrent to Crime", **Canadian Journal of Economics**, 30 (2), Ottawa, Canadian Economics Association, pp. 367-384.

VELIZ, P.; SHAKIB, S. (2012), "Interscholastic Sports Participation and School Based Delinquency: Does Participation in Sport Foster a Positive High School Environment?", **Sociological Spectrum**, 32 (6), Londres, Taylor & Francis, pp. 558-580, doi: https://doi.org/10.1080/02732173.2012.700837

VERMILLION, M. (2007), "Sport participation and adolescent deviance: A Logistic Analysis", **Social Thought & Research**, vol. 28, Lawrence, Sociology Department of University of Kansas, pp. 227-258.