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Total serum cholesterol level, violent criminal offences, suicidal behavior, mortality and the appearance of conduct disorder in Finnish male criminal offenders with antisocial personality disorder

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Abstract Associations between low total serum cholesterol (TC) levels and antisocial personality disorder (ASPD), violent and suicidal behavior have been found. We investigated the associations between TC levels, violent and suicidal behavior, age of onset of the conduct disorder (CD) and the age of death among 250 Finnish male criminal offenders with ASPD. The CD had begun before the age of 10 two times more often in non-violent criminal offenders who had lower than median TC levels. The violent criminal offenders having lower than median TC levels were seven times more likely to die before the median age of death in the study material. The violent offenders having lower than median TC levels were eight times more likely to die of unnatural causes. The mean TC level of these male offenders with ASPD was lower than that of the general Finnish male population. Low TC levels are associated with childhood onset type of the CD, and premature and unnatural mortality among male offenders with ASPD. The TC level seems to

be a peripheral marker with prognostic value among boys with conduct disorder and antisocial male offenders.

Key words Serum cholesterol · antisocial personality disorder · conduct disorder · criminal offending · mortality

Introduction

Antisocial personality disorder (ASPD) which is always preceded by conduct disorder (CD) in childhood (APA 2001) has been reported to be associated with low total serum cholesterol (TC) levels (Virkkunen 1979, 1983; Freedman et al. 1995). The link between aggressive conduct disorder (APA 1980) and low TC levels was reported by Virkkunen and Penttinen (1984). According to a large community cohort (Golomb et al. 2000), low TC concentrations have a significant relationship to violence in the general population. However, low TC levels also occur among subjects with borderline personality disorder without any reported association to crime (New et al. 1999).

In addition, among psychiatric patients, low TC levels and violent behavior seem to be linked (Hillbrand et al. 1995; Mufti et al. 1998). On the contrary, higher TC levels have been correlated with cognitive efficiency and sociability among violent psychiatric inpatients (Hillbrand et al. 2000). Results of studies having no association between TC levels and violent behavior have also been reported among psychiatric patients (Steinert et al. 1999; Huang and Wu 2000).

Mortality among persons having antisocial personality disorder is relatively high in the young, and it is caused by violence, suicides, accidents and substance abuse (Martin et al. 1985; Black et al. 1996). Youth having antisocial behavior are also characterized by a high mortality from unnatural causes (Rydelius 1988). Likewise, associations between low TC levels, violent deaths, violent suicide attempts and suicides have been ob-

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served (Maes et al. 1996; Kaplan et al. 1997; Alvarez et al. 1999, 2000). In large population studies, both very high TC levels (Tanskanen et al. 2000) and the lowest quartile of TC levels (Ellison and Morrison 2001) have been observed to be associated with a high risk of suicide.

It remains unclear how TC levels and central neurotransmitter activity are linked. In monkeys, a low fat diet increases contact aggression (Kaplan et al. 1991), and it has also been suggested that low TC levels provoke hunting behavior in monkeys (Kaplan et al. 1997). Low membrane cholesterol has been suggested to decrease the number of serotonin receptors, and therefore, because of the free exchange of serum and membrane cholesterol, low TC might cause a decrease in central serotonergic activity, resulting in poor suppression of aggressive behavior (Engelberg 1992). Dietary essential fatty acids may, however, be more important than cholesterol in changing central neurotransmitter activity in humans (Hibbeln et al. 1998a, 1998b, 2000). Among cocaine addicts, those subjects having low HDL cholesterol levels had a history of aggression, and exhibit 'high' feelings and 'activation-euphoria' responses to meta-chlorophenylpiperazine (m-CPP) challenges, which is indicative of low brain serotonin activity (Buydens-Branchey et al. 2000). Among healthy males, the m-CPP challenge exhibits a higher serotonergic receptor function in association with higher serum cholesterol (Terao et al. 2000).

Because low TC concentrations have been found in ASPD, which is characterized by low brain serotonin turnover (Virkkunen et al. 1989a, 1989b, 1994), high premature mortality from violence and suicide (Martin et al. 1985; Black et al. 1996), a high risk of criminality (APA 1994), and preceded by childhood conduct disorder (APA 1994), an association between TC levels and the above mentioned phenomena could be expected in male criminal offenders having ASPD. In addition, a high premature mortality from unnatural causes for the present study participants has been reported (Repo-Tiuhonen et al. 2001). Therefore, we investigated the putative link between low TC levels, the age at which conduct disorder begins, the frequency of violent criminal offences, suicidal behavior (including suicide attempts and slashing), and mortality (age and causes) among Finnish male criminals who had a diagnosis of antisocial personality disorder according to DSMIV (APA 1994).

Material and methods

■ Description of the subjects

The subjects were Finnish male criminal offenders who had consecutively been admitted to undergo a forensic psychiatric evaluation according to court order in the Department of Forensic Psychiatry of Helsinki University Central Hospital from 1977–1987, and had received a diagnosis of antisocial personality disorder (ASPD) (WHO 1969). The evaluations, lasting 4–8 weeks, took place in a closed/locked ward of the hospital. One of the researchers (MV) was the Head of the Forensic Psychiatric Department from 1977 to 1987, and carried out himself or supervised all forensic psychiatric evalua-

tions concerned in the present study. A psychiatric diagnosis in 250 cases was determined to be ASPD, according to two forensic psychiatrists (ER-T and MV) who independently reviewed the hospital files using DSM IV criteria (APA 1994). The researchers, using DSMIV criteria, agreed in 250 of 300 consecutive cases who had received the diagnosis of ASPD according to ICD-8 (WHO 1969) from 1977 to 1987 as the result of the forensic psychiatric evaluation. These 250 cases were included in this study. This study was approved by the ethical committee of the Department of Psychiatry of Helsinki University Central Hospital.

■ Medical information

The TC levels had been determined after an overnight fast during the forensic psychiatric investigation. Information concerning the age at which the conduct disorder had appeared was obtained from the files of social services and from standard questionnaires that are used in Finland in forensic psychiatric investigations, in order to receive information from the first-degree relatives. Information concerning suicidal behavior was available only up until the forensic psychiatric evaluation, and this was obtained from hospital files that were searched for previous suicide attempts. Information on mortality and cause of death, where applicable, was obtained from the Finnish population register in 1997.

■ Information of delinquency

Information concerning the criminal offences was obtained from the National Crime Register. The criminal register files were searched for life-time criminal offences since the age of 15 years until 1997. The criminal register information was not available if the person had died, and in those cases the information that was obtained during the forensic psychiatric evaluation was used instead. The National Crime Register contains information on whether the person under consideration is living or deceased.

Homicides and assaults were considered as violent criminal offences. Other ("non-violent") criminal offences committed by the subjects were arson, robbery, stealing, fraud, drunk driving. Sexual criminal offences were rape and child molestation. In the analyses, only those who had committed at least one violent offence were considered as "violent offenders". Those who had committed only sexual or sexual and non-violent criminal offences were excluded ($N = 12$) from the analyses in which the dichotomy of "violent" and "non-violent" was used.

■ Statistics

Because of the varying age at evaluation of TC, stratification was applied according to values of age above and below the median. TC levels less than or equal to the median value (5.3 mmol/l) were regarded as low values. The age at death when less than or equal to the median (39 years) was regarded as "young". Those having an onset of the CD-symptoms at the age of 10 or less had an "early" onset age (childhood onset CD, APA 2001).

Associations between TC, age of onset of CD, the number of violent crimes, slashing and suicide attempts were examined with correlations, or when categorized, with the Mann-Whitney test or χ^2 -test.

A receiver operating characteristic curve (ROC) was used in an attempt to find an optimum level of serum cholesterol that predicts the age of onset of the CD, the number of violent crimes, the age at death, slashing and suicide attempts.

Odds ratios (OR) for the number of violent offences, suicide attempts (yes/no), slashing (yes/no), early age of death and early onset of CD-symptoms were computed for low TC levels compared to high TC levels. The ORs were computed separately for violent and non-violent subjects.

Results

The demographic data of the material are presented in Table 1. The mean TC level of the present material was 5.4 (1.8) mmol/l at the age of 27.3 (9.4) years. The TC level was lower than that of the Finnish general male population between the ages of 25–34 years during the same years (5.6 mmol/l) (Monica Population Survey Data Book).

No association was found between TC levels and the commission of violent crimes. In addition, no association was found between TC levels and the history of suicide attempts and slashing. No associations with these aspects of suicidal behavior were found even after separately studying those who had committed non-violent and violent crimes. In the ROC analysis, no optimum level of TC predicted the onset of CD, the number of violent crimes, the age of death, slashing or suicide attempts but accuracies from the various categorizations of the TC level were poor.

Among those who had committed non-violent criminal offences, symptoms of CD had been found below the

age of 10 two times more often in those subjects having lower TC levels than in those subjects who had higher TC levels (Table 2).

Among those who had committed violent criminal offences, subjects having low TC levels were seven times more likely to die before the median age of death in the study (Table 3). The violent offenders who had a low TC level were eight times more likely to die of unnatural causes (OR 9.35, CI 2.05–42.7), and this association remained after excluding 4 cases who had been killed (OR 10.7, CI 2.08–54.7).

Discussion

The mean TC level in the present study was lower than that of the Finnish general population (Monica Population Survey Data Book), and this result corroborates earlier findings among men with ASPD (Virkkunen 1979, 1983; Freedman et al. 1995).

According to our results, low TC levels in adult age are associated with a history of childhood onset type of conduct disorder (APA 2001) in non-violent criminal offenders. It has been suggested that a conduct disorder is worse the earlier it begins (APA 1994), and children with childhood onset CD have adult ASPD more often than those with adolescent-onset CD (APA 2001). The low TC level may represent a biological marker for childhood onset CD having poor prognosis (APA 2001). This finding has been previously documented among boys having conduct disorder, compared to boys having attention deficit disorder (Virkkunen and Penttinen 1984). Currently, it is accepted that many children with childhood onset CD also have attention deficit hyperactivity disorder (ADHD) (APA 2001; Modestin et al. 2001), due to which the finding could be more prominent when compared to healthy children. However, follow-up studies are needed to determine whether or not there is any association between the TC level and such violent criminal behavior that could be considered as a “bad prognosis”.

Low TC levels were associated with premature deaths among those who had committed violent crimes in this study, and especially with deaths of unnatural causes. This finding may mean that those who have low TC levels also have lower central serotonergic activity, which has been found among Finnish male criminals with ASPD (Virkkunen et al. 1989a, 1989b, 1994). It is likely that in large population studies (Tanskanen et al. 2000;

Table 1 The age at evaluation (years), total serum cholesterol (TC, mmol/l), number of violent offences, onset age of CD symptoms, follow-up time since the age of 15, age at death for the whole study

	N	mean	median	SD	range
Age at evaluation (y)	250	27.3	25.0	9.4	18–71
TC (mmol/l)	247	5.4	5.3	1.18	3–9
Number of violent offences	242	3.0	2.0	4.0	0–26
Onset age of CD symptoms (y)	249	8.8	9.0	3.7	1–14
Follow-up time (y)	250	25.4	24.0	9.7	4–65
Age at death (y)	73	41.0	39.0	13.4	19–80

Table 2 The number (%) of violent and non-violent criminal offenders that were registered as having CD symptoms before and after the age of 10, in groups equal to/lower and higher than the median TC, and odds ratios (OR) and confidence intervals (CI)

	N (%) TC ≤ median	N (%) TC > median	OR	CI
Violent				
CD < 10-y	55 (64.0)	54 (70.1)		
CD > 10-y	31 (36.0)	23 (29.9)	0.76	0.39–1.46
Non-violent				
CD < 10-y	20 (74.1)	17 (47.2)		
CD > 10-y	7 (25.9)	19 (52.8)	3.19	1.08–9.42

Table 3 The number (%) of violent and non-violent criminal offenders who had died younger or older than the median age of death, in groups equal to/lower and higher than the median TC, and odds ratios (OR), and confidence intervals (CI)

		N (%) TC ≤ median	N (%) TC > median	OR	CI
Violent					
Age of death	≤ median	16 (66.7)	4 (20.0)		
	> median	8 (33.3)	16 (80.0)	8.00	2.00–32
Non-violent					
Age of death	≤ median	5 (71.4)	8 (66.7)		
	> median	7 (28.6)	4 (33.3)	1.25	0.16–9.54

Ellison and Morrison 2001) the number of seriously violent and uncooperative criminal offenders with ASPD is so small that the findings of the present study were not discovered. Therefore, prospective follow-up studies concerning the TC level and mortality in ASPD are needed to determine if the low TC level is a peripheral marker with prognostic value.

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