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## Exploring the role of serum lipid profile and neutrophil-to-lymphocyte ratio in violent suicide attempters: a cross sectional study

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Abstract:	<p>Background: Suicidality is one of the most common complications of mental disorders, so that the identification of potential biomarkers may be relevant in clinical practice. To date, the role of serum lipids and Neutrophil/Lymphocyte Ratio (NLR) has been explored albeit with conflicting results. To the best of our knowledge, no study has explored lipid levels concomitantly with NLR in relation to violent suicide attempts. Therefore, we aimed to investigate whether serum lipid levels and NLR might be associated with the violent method of suicide attempts.</p> <p>Methods: The study group consisted of 163 inpatients who attempted suicide. Blood samples were collected at the beginning of hospitalization to measure total cholesterol, Low-Density Lipoprotein (LDL), High-Density Lipoprotein (HDL), Very-Low-Density Lipoprotein (VLDL), Triglycerides (TG) and NLR. Descriptive analyses of the total sample were performed. The included patients were divided into two groups according to violent/non-violent method. Groups were compared in terms of lipid profile and NLR using multivariate analyses of variance with gender and diagnosis as covariates (MANCOVAs).</p> <p>Results: Plasma levels of total cholesterol (<math>F=5.66</math>; <math>p=0.02</math>), LDL</p>

	<p>(F=4.94; p=0.03), VLDL (F=5.66; p=0.02) and NLR (F=8.17; p&lt;0.01) resulted to be significantly lower in patients that used a violent method compared to patients who attempted suicide with a non-violent method. Conclusions: Low cholesterol, LDL and VLDL levels as well as low NLR value were associated with a violent method of suicide attempt in patients with mental disorders. Further studies are needed to confirm these results.</p>

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**Exploring the role of serum lipid profile and neutrophil-to-lymphocyte ratio in violent suicide attempters: a cross sectional study**

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*Original Research*

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**ABSTRACT**

**Background:** Suicidality is one of the most common complications of mental disorders, so that the identification of potential biomarkers may be relevant in clinical practice. To date, the role of serum lipids and Neutrophil/Lymphocyte Ratio (NLR) has been explored albeit with conflicting results. To the best of our knowledge, no study has explored lipid levels concomitantly with NLR in relation to violent suicide attempts. Therefore, we aimed to investigate whether serum lipid levels and NLR might be associated with the violent method of suicide attempts.

**Methods:** The study group consisted of 163 inpatients who attempted suicide. Blood samples were collected at the beginning of hospitalization to measure total cholesterol, Low-Density Lipoprotein (LDL), High-Density Lipoprotein (HDL), Very-Low-Density Lipoprotein (VLDL), Triglycerides (TG) and NLR. Descriptive analyses of the total sample were performed. The included patients were divided into two groups according to violent/non-violent method. Groups were compared in terms of lipid profile and NLR using multivariate analyses of variance with gender and diagnosis as covariates (MANCOVAs).

**Results:** Plasma levels of total cholesterol ( $F=5.66$ ;  $p=0.02$ ), LDL ( $F=4.94$ ;  $p=0.03$ ), VLDL ( $F=5.66$ ;  $p=0.02$ ) and NLR ( $F=8.17$ ;  $p<0.01$ ) resulted to be significantly lower in patients that used a violent method compared to patients who attempted suicide with a non-violent method.

**Conclusions:** Low cholesterol, LDL and VLDL levels as well as low NLR value were associated with a violent method of suicide attempt in patients with mental disorders. Further studies are needed to confirm these results.

**Keywords:** Lipid; NLR; Suicide; Mental disorders; Biomarkers

## 1. INTRODUCTION

Several studies focused on the potential link between neurobiological factors and suicidal behaviors<sup>1</sup>. Of note, the possible role of lipids in modulating mental health was hypothesized according to the observations of an increased number of attempted suicides in subjects treated with lipid-lowering agents<sup>2</sup>, or conversely of an amelioration of mood symptoms in patients affected by major depression and taking statins<sup>3</sup>. In this regard, some studies suggested that statins may have some anti-inflammatory and antioxidant properties, possibly targeting the inflammatory and oxidative pathways associated with the pathophysiology of depression<sup>4</sup>. Furthermore, because patients using statins exhibit a limited risk of cardiovascular events, it cannot be ruled out that a better quality of life may be in turn associated with mood improvements<sup>5</sup>. Despite this, different neuropsychiatric adverse drug reactions such as violence, aggression, intentional injury and mood changes, were described in some observational studies as well as in pharmacovigilance databases regarding lipid-lowering drugs<sup>6</sup>. However, potential confounders in the association between lipid-lowering drugs and behavior modifications were often not taken into account. For instance, lack of exercise is related to higher risk of cardiovascular accidents and was found to be associated with depression. Because hyperlipidemic individuals having this risk factor could be more likely to assume statins than hyper-lipidemic individuals who practice physical exercise, not controlling for physical exercise should turn out to an apparent relationship between statin use and depression<sup>7</sup>. In light of these gaps, in the last years a growing number of studies has investigated the possible relationship between lower serum lipid levels and suicidal behavior on the grounds that suicidal behaviors are more likely to be not a result of lipid lowering therapies, but basically of lower lipid levels<sup>8</sup>. In support of these clinical observations, some biological data show that low peripheral cholesterol and triglyceride levels might be associated with decreased lipids in synaptic membranes, leading to consistent changes in membrane viscosity and gene expression<sup>9</sup>. These variations, in turn, could result in a poor serotonergic activity in lipid rafts, possibly related to a limited suppression of impulsive violent behaviors, such as suicidal conducts<sup>10,11</sup>. An inverse association of suicidality with serum cholesterol and triglyceride levels was also remarked in a recent systematic review and meta-analysis<sup>12</sup>. Even though subgroup analyses revealed a potential association between a lower serum total cholesterol and violent methods of suicide attempts, some studies reported opposite results<sup>12</sup>. As a whole, the studies exploring a possible interaction between lipid serum profile and suicidal behavior in subjects with mental disorders produced mixed results, possibly due to methodological heterogeneity<sup>13,14</sup>. The available data about this topic are also biased by confounding factors such as gender because males are more likely to use violent methods to commit suicide than women<sup>15</sup>. Furthermore, no robust evidence associates the severity of impulsivity with serum lipid profile<sup>16</sup>, partly due to the fact that other biological factors such as the amount of circulating neurosteroids<sup>17</sup> or severity of systemic inflammation<sup>18</sup> can both influence the cholesterol blood levels

and the vulnerability to suicidal behaviors. In this regard recent models included neuroinflammation as an important factor associated with the vulnerability to impulsive behaviours including suicide<sup>19</sup>. Recent studies identified neutrophil-to-lymphocyte ratio (NLR) as a measure of low-grade inflammation in different systemic diseases<sup>20</sup> as well as a potential biomarker related to the severity of psychiatric disorders and suicide<sup>21</sup>. Specifically, a recent meta-analysis reported higher levels of NLR in subjects with bipolar disorder (BD) and major depressive disorder (MDD) than healthy controls<sup>22</sup>. Further studies even suggest that NLR may be a trait marker of suicide vulnerability in patients with BD<sup>23</sup> or MDD<sup>21,24</sup>, although other findings contradicted these results<sup>25</sup>. Furthermore, two different articles<sup>26,27</sup> reported higher levels of NLR in subjects who attempted suicide with a violent method than the counterpart.

According to authors' knowledge, no study has explored till now the concomitant association of lipid serum levels and NLR with violent/nonviolent method of suicide attempt. Thus, in order to overcome gaps of previous research, purpose of the present study was to explore the possible roles of lipid serum levels and of NLR on the occurrence of violent suicide attempts in a sample of patients affected by psychiatric conditions.

## 2. METHODS

This study was drawn up following the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) Statement items<sup>28</sup>. The research project complied with the principles of the Declaration of Helsinki regarding medical research in humans, following local research ethical requirements.

### 2.1 Sample

A sample of 163 subjects aged  $\geq 18$  years was cross-sectionally recruited in a Psychiatric Inpatient Unit (Desio Hospital, ASST Monza, Italy), between January 2012 and December 2019. All patients were included if hospitalized for a suicide attempt occurred within the last 72 hours and if suffered from schizophrenia, BD type I or II (any acute phase), MDD and personality disorders according to ICD-10 criteria. If patient had more than one psychiatric diagnosis, the main psychiatric condition was taken into account (i.e. the disorder that conducted to hospitalization). Moreover, eligible subjects were medically stable, not needing treatment for any physical condition. We excluded subjects suffering from other mental disorders or mental retardation, and those with serious physical illnesses, including hepatitis B or C, and HIV infections (antiviral agents may modify lipid profile), or treated with thyroid hormone, antidiabetic, anticoagulant, antiplatelet, urate- and lipid-lowering agents.

### 2.2 Assessments

All data were anonymously and retrospectively collected, not allowing subject identification. Standard demographic and clinical data (age, gender, nationality, occupational and marital status, characteristics of recent suicide attempts, diagnosis of mental disorders according ICD-10, ongoing psychopharmacological treatments, smoking status, co-occurring substance use disorders and lipid profile) were retrieved from electronic health records. We considered as ‘suicide attempts’, only self-injuries of people willing to die, while suicidal ideation or plans without any action, as well as low-lethal self-harm behaviors, were excluded<sup>24</sup>. We used standard definitions to distinguish violent (firearm, hanging, cutting, jumping, car exhaust, other violent methods) from non-violent (drug overdose and poisoning) methods for attempting suicide<sup>29</sup>. Information on lipid serum levels, including total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), very low density lipoprotein (VLDL), triglycerides (TG) and NLR was retrieved from routine blood tests done in the first hours of hospitalization at 8.00 am, after an overnight fasting. We considered only serum blood tests carried out within 24 hours after the hospitalization. Serum lipid concentrations were examined using standard methods (enzymatic colorimetric ones) at the Department of Clinical Pathology of Desio Hospital, ASST Monza, Italy.

### *2.3 Statistical analyses*

The data were analyzed using Statistical Package for Social Sciences – SPSS 26.0. Characteristics of the total sample were reported using mean and standard deviation (SD) for quantitative variables and frequencies and percentages for qualitative ones. Selected patients were divided into two groups according to the presence of violent or non-violent suicide method. Quantitative and qualitative variables were respectively compared between the two groups by multivariate analyses of variance (MANOVAs) and chi-square tests with eventual Bonferroni’s post hoc analyses. Finally, multivariate analyses of variance, inserting gender and psychiatric diagnoses as covariates (MANCOVAs) were performed to compare the two groups in terms of lipid profile and NLR.

A p value of  $\leq 0.05$  was considered as statistically significant.

## **3. RESULTS**

A total of 163 patients hospitalized for a recent suicide attempt were included in the study. Almost a third of the sample had experienced a violent suicide attempt in the 72 h before admission. As a whole, 17 individuals had schizophrenia, 19 BD, 37 MDD and 90 a personality disorder. More than 40% of the subjects was treated with antidepressants. Moreover, more than half of the sample was a smoker whilst about one in five patients had a comorbid substance use disorder. Descriptive analyses of the total sample and of the groups divided according to the type of suicide attempts are reported in Table 1.

*Table 1 about here*

The groups of patients divided according to violent/non-violent attempted suicide were significantly different in terms of gender ( $\chi^2=9.46$ ;  $df=1$ ;  $p<0.01$ ), antidepressant treatment ( $\chi^2=15.85$ ;  $df=1$ ;  $p<0.001$ ) and smoking status ( $\chi^2=4.90$ ;  $df=1$ ;  $p=0.04$ ). Indeed, male individuals were more likely to attempt suicide with a violent method than females. Furthermore, patients with a violent suicide attempt were more frequently smokers and were taking less antidepressant treatment than patients that attempted suicide in a non-violent way. On the other hand, we did not find significant differences between the two groups in age ( $F=1.44$ ;  $p=0.23$ ), employment status ( $\chi^2=0.28$ ;  $df=1$ ;  $p=0.60$ ), marital status ( $\chi^2=0.50$ ;  $df=1$ ;  $p=0.57$ ), psychiatric diagnosis ( $\chi^2=2.80$ ;  $df=3$ ;  $p=0.43$ ), first-generation antipsychotic treatment ( $\chi^2=1.14$ ;  $df=1$ ;  $p=0.32$ ), second-generation antipsychotic treatment ( $\chi^2=3.42$ ;  $df=1$ ;  $p=0.08$ ), treatment with mood stabilizers ( $\chi^2=0.48$ ;  $df=1$ ;  $p=0.63$ ) and presence of a substance use disorder ( $\chi^2=0.22$ ;  $df=1$ ;  $p=0.67$ ).

Finally, serum levels of total cholesterol ( $F=5.66$ ;  $p=0.02$ ), LDL ( $F=4.94$ ;  $p=0.03$ ), VLDL ( $F=5.66$ ;  $p=0.02$ ) and NLR ( $F=8.17$ ;  $p<0.01$ ) were significantly lower among patients using a violent method compared to patients with a non-violent method of suicide attempt (Figure 1).

*Figure 1 about here*

Similarly, lower HDL ( $F=0.006$ ;  $p=0.94$ ) and TG ( $F=0.05$ ;  $p=0.82$ ) serum levels were found in violent versus non-violent suicide attempters, but these differences did not achieve statistical significance.

## 4. DISCUSSION

### 4.1 Main findings

In this study, based on real world sample of inpatients with different mental disorders, we found that subjects who attempted suicide with violent method showed lower serum levels of total cholesterol as well as of LDL and VLDL sub-fractions compared to their counterpart. In addition, NLR was significantly lower in violent versus non-violent suicide attempters.

Our results are consistent with a previous meta-analysis by Wu and colleagues<sup>12</sup> and with a recent case-control study<sup>30</sup> which found lower serum total cholesterol and LDL levels in patients with high-lethality suicide attempts compared to low-lethality suicide attempters. Moreover, we found no differences in HDL and TG between non-violent and violent suicide attempters similarly to previous studies<sup>31</sup>. However, the literature exploring a possible interaction between low lipid levels and the method of suicide attempt in subjects with mental disorders produced mixed results<sup>32,11</sup>. In particular, the high methodologically heterogeneity across studies due to the different assessment of suicide attempts<sup>30</sup>, the type of included mental disorders<sup>33</sup> as well as the role of possible confounders (i.e. economic factors, dietary patterns, body mass index-BMI,



physical conditions, infectious disease, medical treatments, other psychological characteristics and current psychopharmacological treatment) should be taken into account<sup>30,14</sup>. Nevertheless, the different sub-fractions of cholesterol (pro-atherogenic lipids, i.e. LDL, VLDL and TG vs anti-atherogenic lipids, i.e. HDL) may have distinct roles in brain function and therefore in influencing the risk of suicide, although no definitive answers to this question exist<sup>34</sup>. Thus, different possible explanations were suggested to account for the association between cholesterol and suicidal behaviors<sup>17</sup>. In particular, since violent suicide attempters usually have higher levels of aggressiveness and impulsivity, and more adult interpersonal violence and suicide risk than non-violent attempters<sup>35</sup>, serum cholesterol might be more linked to the violence of suicide attempts than to suicide itself<sup>13</sup>. In support to this consideration a correlation between infant exposure to violence and adult violent behaviors (i.e. cycle of violence) was found in subjects with lower serum cholesterol levels<sup>36</sup>. Early life adverse experiences (ELAs), such as sexual or physical abuse and parental neglect, are distal events related to suicide behaviors<sup>37</sup>. ELAs may produce chronic psychological stress and epigenetic modifications of multiple genes including those implicated in regulation of cholesterol levels and stress responses<sup>36</sup>. In this regard, some studies reported that apolipoprotein E (ApoE), that it is involved in the formation of synapses and prevention of neuronal death, might be associated with decreased lipid levels, which in turn might be related to the severity of suicidal behaviour<sup>38,39</sup>. Nevertheless, some studies suggest that some cholesterol metabolites called oxysterols may cross the blood-brain barrier leading to modifications in Central Nervous System (CNS) cholesterol levels and lipid raft activity resulting in impairment of synaptic 5-HT transmission<sup>19</sup>. As a consequence of altered phospholipid and cholesterol contents in CNS, a study reported that violent suicide completers may display a lower grey matter lipid content in both ventral prefrontal and orbitofrontal cortex than non-violent suicidal people<sup>9</sup>. However, the debate in the relationship between serum lipids and suicide is still ongoing. For example, an alternative hypothesis is that low serum cholesterol levels are explained by the over-production of neurosteroids promoting self-harm behaviours in suicide attempters such as dehydroepiandrosterone sulfate (DHEAs)<sup>40</sup>. Furthermore, serum lipids may just represent an epiphenomenon of suicide attempts, interplaying with more complex processes, specifically associated with the dysregulation of the hypothalamic-pituitary-adrenal axis and inflammation<sup>41</sup>. In particular, Interleukin-6 (IL-6), is hypothesized to be involved in the pathophysiology of suicidal behavior since it may promote inflammation with consequent astrocyte and microglial activation<sup>42</sup>. IL-6 may be overproduced by microglia or may enter in the brain from the periphery via a compromised blood-brain barrier<sup>43</sup>. In this regard, NLR is currently considered a reliable marker of low-grade systemic inflammation<sup>22</sup>. Our study found that individuals who committed a suicide attempt with violent method had a lower NLR compared to non-violent ones. This result seems to conflict with two consecutive studies<sup>26,27</sup>, which found higher NLR values in violent suicide attempters in comparison to non-violent suicide

attempters and healthy controls. However, it appears to be difficult to compare our results with those reported by Orum<sup>26</sup> and Kara<sup>27</sup> since they excluded patients with a history of psychiatric treatments and with current psychiatric disorders, apart from those with major depression or anxiety, whilst we included a sample of patients affected by psychiatric disorders requiring hospitalization. As a whole, to our knowledge, few articles investigated the potential role of NLR in suicidal behavior and these studies present different methods and samples than our research<sup>25,44</sup>. Nevertheless, even though most studies reported higher levels of NLR in suicide attempters than individuals without suicidal behavior, these results can be discordant respect to our findings for the following reasons. First of all, the severity of depression and suicide may be related to distinct immune-biological profiles in peripheral blood<sup>45</sup>. This aspect is also supported by our findings as subjects with non-violent suicide attempts were more frequently in treatment with antidepressants. In addition, a very recent study confirmed that the severity of depressive symptoms is linearly associated with LDL serum levels, but no changes in NLR<sup>46</sup>. Furthermore, suicidal behavior may be accompanied by an increased number of lymphocytes whereas depressed patients may be less likely to show elevated lymphocytes<sup>47</sup>. Similarly, distinct patterns of inflammation might be associated with a different impairment in self-regulation and consequently with a variable risk of impulsivity and violent suicide attempts<sup>48,49</sup>. Second, most studies about the association between inflammation and suicide considered the total count of white blood cells while just few studies examined lymphocyte subtypes. For instance, patients affected by post-traumatic stress disorder, a condition associated with high risk of suicide, can show a decreased number or a decreased functional capacity of natural killer cells as a result of the high glucocorticoid receptor expression on lymphocytes<sup>50</sup>. In addition, cortisol may promote the differentiation of regulatory T lymphocytes as well as repress the production of T-helper 1 and T-helper 17 lymphocytes<sup>51,41</sup>. Third, many possible confounders should be considered in the potential association between NLR and suicide attempts. In particular, our study found significant differences between non-violent and violent suicide attempts in terms of gender, frequency of antidepressant treatment and smoking status. One study reported statistically significant differences in NLR between men and women<sup>52</sup> and another article found that the NLR is normalized by the antidepressant treatment in subjects affected by MDD<sup>53</sup>. Finally, smoking seems to affect NLR values<sup>54</sup> and a recent study, conducted on patients undergoing coronary intervention, reported that changes in the lipid profile influence the variability of NLR in the light of the inflammatory properties of atherogenic lipids<sup>55</sup>. Taken as a whole, in the light of the above mentioned considerations, we cannot fully exclude that lower serum levels of total cholesterol, LDL and VLDL are concomitant with lower levels of NLR among patients using a violent method compared to patients with a non-violent suicide attempt.

#### *4.2 Limitations*

There are some important methodological limitations in the present study and results should be interpreted cautiously. First, as this study was a cross-sectional one, we cannot definitively define whether the selected variables preceded or followed the suicide attempt. Consequently, we could not evaluate the direct causal relationship between suicidal behavior and lipid profile as well as NLR. Second, the sample size was relatively small and almost all subjects were Italian inpatients from one hospital, which limit the generalization of our findings. For the same reason we were unable to stratify the sample according to the different type of mental disorders. Third, since data were retrieved from electronic medical charts, without information from face to face interviews, some variables including previous suicide attempts, poor adherence to medications, dietary habits, nutritional status, physical activity and BMI, were not available<sup>56,57</sup>. Fourth, we should consider that most subjects were treated with psychopharmacological agents, leading to a possible alteration of lipid serum levels and NLR. Indeed, it is widely known that both first- and second-generation antipsychotics as well as antidepressant treatments may cause lipid dysregulation, thereby contributing to the onset of the metabolic syndrome<sup>58,59,60</sup>. Moreover most mood stabilizers, including valproic acid, carbamazepine, lamotrigine and lithium could be typically associated with alterations of Leukocyte Count<sup>61</sup>, leading to possible change of NLR<sup>62</sup>. However, we excluded subjects with physical conditions or medical treatments, in particular lipid lowering agents, that may interfere with lipid metabolism and NLR values. Furthermore, we considered only certain mental disorders, excluding those conditions (i.e., eating disorders, organic mental disorders and mental retardation) that might confound the association between lipids, NLR and suicidal behaviors<sup>63</sup>. Nevertheless, we cannot fully ruled out that part of our sample may be affected by subclinical conditions (e.g. hypothyroidism, cardiovascular and autoimmune diseases, infections) which in turn may translate into alterations of both lipid metabolism and NLR<sup>64,65,66</sup>.

## 5. CONCLUSIONS

Despite some limitations, the current study may support previous evidence of lower serum lipids in subjects with mental disorders and who attempted suicide with violent method as compared with non-violent attempters. Moreover, low NLR levels might increase the risk of violent suicide attempts. To the best of our knowledge, no previous studies investigated lipid profiles concomitantly with NLR and other confounding factors in relation to the violence of suicide attempts. NLR could be a biomarker of clinical utility to stratify psychiatric subjects according to diagnoses or severity of symptoms<sup>67</sup>. Further studies should therefore focus on this parameter, including other important markers of inflammation such as glucocorticoids, cytokines and lymphocyte subpopulations<sup>45</sup>. Longitudinal studies on larger samples of subjects, stratified by type of mental disorder, could better clarify the role of some biological pathways in the onset of suicidal behavior.

## DECLARATIONS OF INTEREST AND FINANCIAL DISCLOSURE

The authors have no conflict of interest with any commercial or other association in connection with the submitted article.

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**Table 1.**  
**Clinical characteristics of the total sample and of the two groups identified according to the method of suicide attempt**

Variables	Total sample N=163	Violent method N=51 (31.3%)	Non-violent method N=112 (68.7%)	p-value
<b>Sociodemographic</b>				
Age (years) <i>mean (SD)</i>	40.5 (12.2)	42.1 (14.1)	38.1 (13.1)	0.23
Female gender	77 (47.2%)	15 (29.4%)	62 (55.4%)	<b>&lt;0.01</b>
Ethnicity (Non-Caucasian)	16 (9.8%)	5 (4.5%)	11 (21.6%)	1.00
Unemployed*	70 (45.8%)	20 (42.6%)	50 (47.2%)	0.60
Married*	45 (27.6%)	16 (32.6%)	29 (27.1%)	0.57
<b>ICD-10 primary diagnosis</b>				
- Schizophrenia	17 (10.4%)	8 (15.7%)	9 (8.0%)	0.43
- Bipolar disorder	19 (11.7%)	7 (13.7%)	12 (10.8%)	
- Major depressive disorder	37 (22.7%)	11 (21.6%)	26 (23.2%)	
- Personality disorder	90 (55.2%)	25 (49.0%)	65 (58.0%)	
<b>Medication before admission*</b>				
- FGA	11 (6.5%)	5 (10.0%)	6 (5.4%)	0.32
- SGA	41 (25.5%)	8 (16.0%)	33 (29.7%)	0.08
- Mood Stabilizers	24 (14.7%)	6 (12.0%)	18 (16.2%)	0.63
- Antidepressants	66 (41.0%)	9 (18.0%)	57 (51.3%)	<b>&lt;0.001</b>
<b>Smoking*</b>	84 (52.0%)	31 (86.1%)	53 (66.2%)	<b>0.04</b>
<b>Comorbid substance use disorder*</b>	31 (20.7%)	11 (22.9%)	20 (19.6%)	0.67

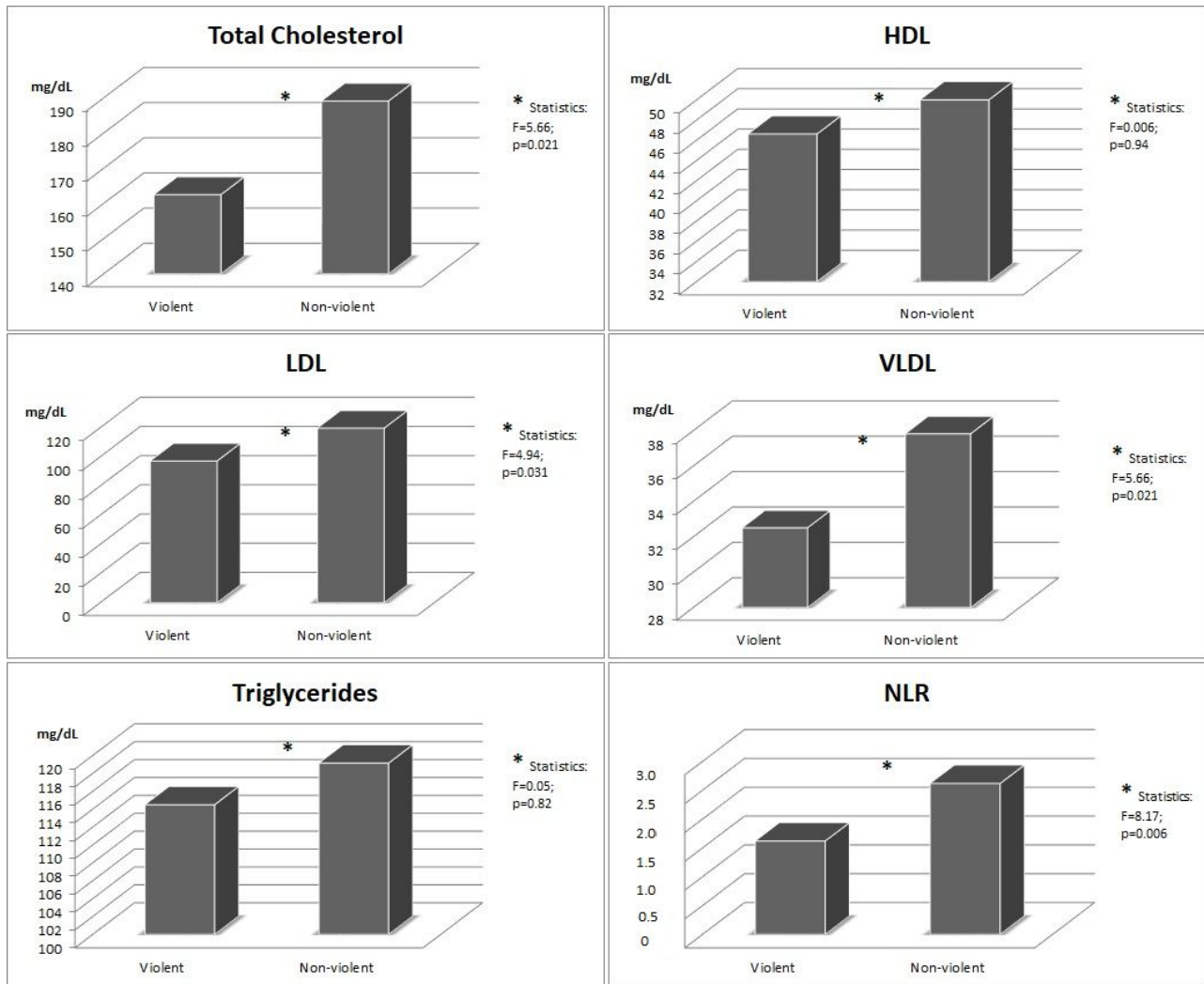
Notes. Values are numbers (column %), unless stated;

\*There are missing values for some variables: the greatest number of missing values is for smoking and comorbid substance use disorder, with 79 (48.4%) and 132 (81%) missing values, respectively.

FGA=first generation antipsychotics; SGA= second generation

p values in bold indicate statistically significant differences between groups

**Figure 1.**  
**Lipid profile and NLR in violent versus non-violent suicide attempts**



Multivariate analyses of variance adjusted for gender and diagnosis

HDL = High-Density Lipoprotein; LDL = Low-Density Lipoprotein; VLDL = Very-Low-Density Lipoprotein; NLR = Neutrophil/Lymphocyte Ratio.