Revised

Markers of sympathetic nervous system activity associate with complex plasma lipids in metabolic syndrome subjects

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Abstract

Context: Plasma and membrane sphingolipids including ceramides, and gangliosides are associated with insulin resistance (IR) through effects on insulin signalling and glucose metabolism. Our studies of subjects with Metabolic Syndrome (MetS) have shown close relationships between IR and sympathetic nervous system (SNS) activity including arterial norepinephrine (NE) levels.

Objectives: We have therefore investigated in MetS subjects possible associations of IR and SNS activity with complex lipids that are involved in both insulin sensitivity and neurotransmission.

Participants and Methods: Cross-sectional assessment of 23 lipid classes/subclasses (total 339 lipid species) by tandem mass spectrometry in 94 overweight untreated subjects with IR (quantified by HOMA-IR, Matsuda index and plasma insulin).

Results: We show that independently of IR parameters, several circulating complex lipids associated significantly with arterial NE and NEFA (non-esterified fatty acids) and marginally with heart rate (HR). After accounting for BMI, HOMA-IR, systolic BP, age, gender, and correction for multiple comparisons, these associations were significant ($P<0.05$): NE with ceramide, phosphatidylcholine, alkyl- and alkenylphosphatidylcholine and free cholesterol; NEFA with mono- di- and trihexosylceramide, G_{M3} ganglioside, sphingomyelin, phosphatidylcholine , alkyl- and alkenylphosphatidylcholine, phosphatidylinositol and free cholesterol; HR marginally ($P=$ or $<0.1>0.05$) with ceramide, G_{M3} ganglioside, sphingomyelin, lysophosphatidylcholine, phosphatidylinositol , lysophosphatidylinositol and free cholesterol. Multiple subspecies of these lipids also significantly associated with NE and NEFA. None of the IR biomarkers associated significantly with lipid classes/subclasses after correction for multiple comparisons.

Conclusions: First demonstration that arterial norepinephrine and NEFA that reflect both SNS activity and IR associate significantly with circulating complex lipids independently of IR suggesting a role for such lipids in neural mechanisms such as operate in MetS.

Key terms: Sympathetic nervous system activity, metabolic syndrome, lipidomics, norepinephrine, NEFA, insulin resistance

Abbreviations

SNS: sympathetic nervous system

IR: insulin resistance

NEFA: non-esterified fatty acids

MetS: metabolic syndrome

BMI: body mass index kg/m^2

HOMA-IR: homeostasis model assessment of insulin resistance

LDL: low density lipoprotein

HDL: high density lipoprotein

Introduction

Elevated sympathetic nervous system (SNS) activity has been consistently demonstrated in subjects who are overweight and insulin resistant (1-4). Both endogenous and exogenous hyperinsulinemia elicit increased SNS activity (5,6) and an inverse relationship has been demonstrated between arterial norepinephrine concentration and insulin clearance (7).

The relationship between hyperinsulinemia, a hallmark of insulin resistance and parameters of SNS activity appear reciprocal We have shown that reducing energy intake and/or increasing energy output leads to improved insulin sensitivity, diminished SNS activity and lower arterial norepinephrine concentration (8). Furthermore as shown by Straznicky et al weight loss induced greater reduction in SNS activity in subjects who were most hyperinsulinemic (9).

Obese insulin resistant subjects also show increased concentrations of complex lipids in plasma and in cell membranes. Ceramides in plasma and tissues associate significantly with insulin resistance (10,11) probably through interfering with insulin signalling (12); rising plasma ceramide levels may precede insulin resistance (IR) (12). Sphingolipids and gangliosides also associate with impaired insulin sensitivity (12,13). Sphingolipids with cell signalling properties as well as structural roles appear to impair insulin sensitivity in key tissues of diabetic subjects (12). Reduced concentrations of plasma lysophosphatidylcholine have been reported in obese and type 2 diabetic subjects (14). In an Australian cohort of subject with prediabetes and type 2 diabetes, Meikle et al (15) reported elevated levels of plasma ceramides, phosphatidylcholine, phosphatidylethanolamine and phosphatidylinositol but reduced concentrations of plasma ether-linked phospholipids including plasmalogens.

Thus both increased arterial norepinephrine concentration and levels of complex lipids clearly associate with the insulin resistant state. Complex lipids including plasmalogens also constitute a major part of the nervous system. Sphingolipids including ceramides and ganglioside lipids exert

83 regulatory roles in the nervous system presumably through effects on biophysical properties of
84 membranes as well as on membrane receptors and signal transduction (16). We have therefore
85 explored the possibility that phospholipids and other complex lipids may associate with
86 norepinephrine metabolism measured as the norepinephrine concentration in arterial plasma. We
87 have also analysed the association between such lipids and other parameters reflecting SNS activity
88 namely plasma non-esterified fatty acids (NEFA) and heart rate. The studies were conducted in 94
89 subjects with metabolic syndrome (MetS) who were free of pharmacologic intervention.

90

Subjects and Methods

Subjects

Non-smoking subjects (n=94, Table 1), aged 45 to 65 yr, were recruited on the basis of being overweight (BMI> 27) and fulfilling criteria for MetS (17). They were enrolled predominantly from studies of weight loss through diminished food intake and exercise. The interventions have been published (4,7); plasmas at baseline had been stored at -80C for <8yr and form the basis of the present investigation. None of the subjects took prescribed medication for hypertension, diabetes or dyslipidemia. Exclusion criteria included abnormal hepatic, renal or thyroid function. Before venesection they had been fasting >12hr and had abstained from alcohol for >36hr and from caffeine for >18hr.

Insulin sensitivity/resistance was assessed through measurement of blood glucose and insulin concentrations during a standard 75g oral glucose tolerance test with calculation of HOMA-IR (18) and Matsuda Index (ISI) (19). Arterial blood for the measurement of norepinephrine concentration was sampled from the brachial artery in the supine position after 30 min supine rest. Blood pressure and heart rate were recorded by Dinamap (Model 1846SX, Critikon Inc, Tampa, FL, USA) as the average of five supine readings after 5 min supine rest.

Laboratory measurements

Plasma concentrations of norepinephrine were determined by high- performance liquid chromatography with electrochemical detection; intra- and inter-assay coefficients of variation were 1.3% and 3.8% respectively. Insulin was quantified by radioimmunoassay (Linco Research, St Charles,MO). Plasma glucose and non-esterified fatty acids (NEFA) were measured by enzymatic and colorimetric methods (Architect C 18000 analyzer, Abbott Laboratories, Illinois, USA and Pure Chemical Industries Ltd, Osaka, Japan respectively).

Lipidomic analyses

Lipids were extracted from plasma samples using a single phase chloroform/methanol extraction process, incorporating an internal standard mix containing stable-isotope labelled and non-physiological standards (Supplementary Table 1), as described previously (15,20) (see Supplementary Material for details). A plasma quality control sample (pooled plasma from six healthy individuals) as well as blank samples (no plasma) were analysed for each 20 participant samples to monitor assay performance.

Lipidomic analyses was performed by electrospray ionization tandem mass spectrometry with the use of an Agilent 1290 liquid chromatography system combined with an 6490 triple quadrupole mass spectrometer with a turbo-ionspray source (200°C) (Agilent Technologies, Singapore).. A total of 339 lipid species from 23 classes/subclasses were measured using our modified lipidomic protocol (see supplementary Material for details). The concentration of each lipid species was calculated by relating the peak area of each lipid species to the peak area of the corresponding internal standard. The concentrations of each lipid class/subclass were calculated by summing the lipid species within each class/subclass. The relative concentration of plasma lipids were expressed in pmol/mL. We recognise the limitations of lipidomic measurements to provide accurate quantification of many hundreds of individual lipid species with the relatively few internal standards currently available; we report relative concentrations as an indication only.

Statistical analyses

Demographic and clinical characteristics were expressed as mean ± SEM (95% CI) or median with interquartile range) using SigmaStat version 3.5 (Systat Software Inc, Point Richmond, CA, USA). Prior to statistical analyses the lipidomic measurements were log transformed and then normalized to interquartile range for ease of interpretation. The relationships between plasma lipids (or predictors) and norepinephrine, NEFA and heart rate (or outcomes), parameters that reflect SNS activity, were evaluated using linear regression models. Diagnostic plots including plots of residuals vs. the fitted values, normal Q-Q plots and scale-location plots were examined to test the assumptions of the

linear regression analysis. Further, the normality of the residuals from the linear regression models was tested using the Kolmogorov Smirnov test. All the assumptions were satisfied for lipids against NEFA and HR. However, norepinephrine (NE) required log transformation for the assumptions to be satisfied. Each analysis was adjusted for age and sex as well as for the main characteristics of MetS including BMI, systolic blood pressure and HOMA-IR. The resultant beta-coefficients characterize the change in the outcome measure (log norepinephrine, NEFA and heart rate) associated with an interquartile range increase in the plasma lipid measurement. All p-values were reported before and after correction for multiple comparisons (n=339 for lipid species, n=23 for lipid classes/subclasses) using the Benjamini-Hochberg approach; p-values ≤0.05 after correction were considered as significant. Partial correlation analyses and part correlation analyses were performed to further assess the association of each lipid class/subclass with the outcome variables NE, NEFA and HR, whilst controlling for the effect of covariates age, sex, BMI, HOMA and SBP. The partial correlation of the lipids measures the strength and significance of the linear association between the lipids and the outcome variable given the other covariates in the model. The square of the part correlation (semi-partial correlation) coefficient indicates the additional proportion of variation in the outcome (NE, NEFA or HR) that is explained by adding the particular lipid to the regression model, which already has a set of covariates (age, sex, BMI, HOMA and SBP).

Results

Subjects

The clinical characteristics of the participants are shown in Table 1. Their BMI was on average 32.9±0.6 kg.m^2 (mean ± SEM) with large waist circumference averaging 107±1.1 cm including the large female cohort (40%). Among standard lipid parameters both low-density lipoprotein cholesterol (LDL-C) and triacylglycerol were modestly above the normal range. Insulin resistance was clearly evident with elevated blood glucose and plasma insulin concentrations and the calculated value for HOMA-IR that was almost twice the upper accepted level for IR thus fulfilling the criteria for metabolic syndrome (17). In addition 40 healthy subject were included as a reference control for the lipidomic profile of the MetS group.

Lipidomic measurements

We measured 339 lipid species from 23 lipid classes/subclasses. All lipid species were detected and quantified in all plasma samples analyzed. The median coefficient of variation (%CV) of the plasma quality control samples (n=10) was 9.2%, with 90% of the lipids having %CV values below 19.4%. The %CV for each lipid species is shown in Supplementary Table 2.

Association of lipid classes/subclasses and species with MetS

The differences in demographic and clinical characteristics of the MetS and control subjects are shown in Supplementary Table 3. They were of similar age and lean and differed significantly in all the measured metabolic parameters. Sixteen of the 23 lipid classes/subclasses and 216 of the 339 lipid species were significantly different between MetS and control after correction for multiple comparisons (Supplementary Tables 4 and 5). Main characteristics of the differences between the two groups resembled those previously reported (15) and provided assurance with respect to the lipidomic profile of the MetS group.

Associations among covariates

The initial analysis focused on the associations among key study variables. We were aware that in this population there may be a significant association between arterial norepinephrine and insulin resistance and that the components of insulin resistance (BMI, glucose and insulin concentrations, HOMA-IR and Matsuda index) would be strongly interrelated. In linear regression analyses, adjusting for age and sex, several components of insulin resistance were significantly associated with BMI as the outcome (Table 2). HOMA-IR as the outcome was also predicted by several biomarkers of insulin resistance noting that Matsuda index was negatively associated.

Three surrogate parameters of putative SNS activity, arterial norepinephrine, NEFA and heart rate were analyzed against predictors of insulin resistance (Table 2). Heart rate and NEFA as outcomes associated significantly with several indices of IR adjusted for age and sex. Arterial norepinephrine associated significantly with the insulin concentration, the latter after adjustment for BMI, HOMA-IR and systolic blood pressure, in addition to age and sex.

Associations between lipid classes/subclasses and species and covariates

Taking into account the associations among the key parameters as shown in Table 2, we focused on associations with the lipid classes/subclasses. For key components of insulin resistance, namely BMI, plasma insulin, HOMA-IR and Matsuda index, associations with several lipid classes were significant when adjusted only for age and sex but none of the associations remained significant with any lipid class after correction for multiple comparisons and those results are not shown.

Associations of the three putative indicators of SNS activity (recognizing their links also to insulin resistance), arterial norepinephrine concentration, NEFA and heart rate, with lipid classes were analyzed in a model that accounted for age, sex, BMI, HOMA-IR and systolic blood pressure. The findings are shown in Tables 3-5 initially without correcting statistically for multiple comparisons (23

204 lipid class/subclasses, each representing the total lipid species within that class/subclass) and then
205 with correction.

206 After adjusting for age, sex, BMI, systolic blood pressure and HOMA-IR, arterial norepinephrine was
207 associated with dihydroceramide, ceramide, dihexosylceramide, trihexosylceramide, sphingomyelin,
208 phosphatidylcholine, alkylphosphatidylcholine, alkenylphosphatidylcholine and free cholesterol
209 (Table 3). All of the associations, with the exception of trihexosylceramide and phosphatidylcholine
210 remained significant after correction for multiple comparisons.

211 After adjustment for age, sex, BMI, systolic blood pressure and HOMA–IR, NEFA associated with
212 monohexosylceramide, dihexosylceramide, trihexosylceramide, G_{M3} ganglioside, sphingomyelin,
213 phosphatidylcholine, alkylphosphatidylcholine, alkenylphosphatidylcholine, phosphatidylinositol,
214 lysophosphatidylinositol and free cholesterol. Importantly all of these associations, with the
215 exception of lysophosphatidylinositol, remained significant after correction for multiple comparisons
216 (Table 4).

217 Heart rate after adjusting for age, sex, BMI, systolic blood pressure and HOMA-IR, associated with
218 ceramide, G_{M3} ganglioside, sphingomyelin, lysophosphatidylcholine, phosphatidylinositol,
219 lysophosphatidylinositol and free cholesterol (Table 5). However, none of these remained significant
220 ($0.05<P\leq0.1$) after correcting for multiple comparisons. Nevertheless the data are interesting
221 because of the resemblance to lipid findings with norepinephrine and NEFA.

222 While Tables 3-5 provide values only for lipid class/subclasses, the findings are supported by the
223 large number of significant associations between respectively NEFA and norepinephrine on the one
224 hand and multiple lipid species with differing acyl residues within the class/subclasses on the other.
225 Such significant associations after correcting for multiple comparisons were found between NEFA
226 concentration and multiple species of G_{M3} ganglioside, sphingomyelin, phosphatidylcholine,
227 alkylphosphatidylcholine, alkenylphosphatidylcholine and phosphatidylinositol (Supplementary

Table 6). Norepinephrine concentration associated significantly with several classes including sphingomyelin, phosphatidylcholine, alkylphosphatidylcholine, alkenylphosphatidylcholine and with 90 lipid species, primarily from the same classes/subclasses. However, only one lipid species, (PC(O-36:2), was significant after correction for multiple comparisons. The associations appeared to be mainly with species containing long-chain fatty acids predominantly with highly polyunsaturated acyl residues.

In summary, whereas NEFA concentration, heart rate and to a lesser degree norepinephrine were significantly associated with parameters of insulin resistance (Table 2), arterial norepinephrine and NEFA also showed significant associations with several lipid classes/subclasses (Tables 3 and 4) as well as a number of lipid species within the classes (Supplementary Table 6). Furthermore there was concordance between the lipid classes/subclasses that associated with norepinephrine, NEFA and heart rate.

Partial correlation analysis and part correlation analysis of lipid classes/subclasses with norepinephrine, NEFA and heart rate

The partial correlation coefficients and the majority of the part correlation coefficients were significant for the lipid classes/subclasses that were significantly associated with the outcome variables in the linear regression analyses, further confirming the conclusions of our study (Supplementary Tables 7-9). Furthermore, the partial correlation coefficients for these lipid classes/subclasses are similar in magnitude to the Pearson correlation coefficients (zero-order correlations), indicating that the relationship between these lipids and the outcome variables are not significantly influenced by other covariates (age, sex, BMI, HOMA-IR and SBP).

Six lipid classes/subclasses showed a significant part correlation with logNE after correction for multiple comparisons (Supplementary Table 7), with age also showing a significant correlation in each analysis. These included the five classes/subclasses that were significantly associated with

logNE in the linear regression analysis (Table 3). Alkylphosphatidylcholine showed the strongest association with logNE, with a standardized coefficient of 0.417 (and 0.356 for age). The partial correlation coefficient of was 0.442 implying that after age, sex, BMI, HOMA-IR and SBP have been statistically controlled, there was a moderate linear relationship between alkylphosphatidylcholine and logNE. Furthermore, alkylphosphatidylcholine had a part correlation coefficient of 0.4060 and this explains an additional 16% of the variation in logNE, over and above that explained by the other predictors (age, sex, BMI, HOMA-IR and SBP).

While six lipid classes/subclasses showed a significant part correlation with NEFA, none of these significance remained after correcting for multiple comparisons. Sex and BMI were the other important variables showing a significant correlation in each analysis (Supplementary Table 8). GM3 ganglioside showed the strongest association with NEFA, with a standardized coefficient of 0.317 (with 0.436 and 0.347 for sex and BMI respectively). The part correlation coefficient for GM3 ganglioside was 0.299 and this explains an additional 9% of the variation in NEFA, over and above that explained by the other predictors (age, sex, BMI, HOMA-IR and SBP).

Five lipid classes/subclasses showed a significant part correlation with HR but these did not remain significant after correction for multiple comparisons (Supplementary Table 9). Sphingomyelin showed the strongest association with HR, with HOMA also showing a significant correlation with HR (standardized coefficients 0.302 and 0.305 respectively). The part correlation coefficient for sphingomyelin was 0.273 and this explains an additional 7% of the variation in HR, over and above that explained by the other predictors (age, sex, BMI, HOMA and SBP).

Discussion

Our main and novel findings relate to the significant associations between several circulating complex lipids, sphingolipids, ganglioside and phospholipids and the concentrations of arterial norepinephrine , plasma NEFA and to a lesser extent with heart rate. Although each of the three parameters also relates to both insulin resistance and obesity (Table 2), none of the specific parameters of insulin resistance (BMI, HOMA-IR, fasting plasma insulin or glucose levels) was found to be significantly associated with any lipid class/subclass after correcting for multiple comparisons. Since arterial norepinephrine, NEFA and heart rate are also regulated by activity of the SNS, their association with the complex lipid classes may derive in part from a common pathophysiological relationship with the SNS. It is noteworthy that there is a degree of commonality among the lipid classes that associated significantly with the three investigated parameters of SNS activity (Tables 4-5 univariate and multivariate analyses). Ceramide, sphingomyelin and alkyl and alkenylphosphatidylcholine were associated with all three parameters whereas phophatidylinositol, lysophasphatidylinositol and GM3 ganglioside associated also with two parameters. Partial correlation analysis supported these findings.

Nevertheless these inter-relationships do not exclude a link to insulin resistance since several of these lipids, and ceramides in particular are known to be strongly associated with insulin resistance and type 2 diabetes (12). Importantly however, in this current study the associations between the plasma concentrations of norepinephrine and NEFA and that of the complex lipids were independent of biomarkers of insulin resistance BMI and HOMA-IR.

The interrelationships between measures of insulin resistance and SNS activity are multiple. The SNS is stimulated when plasma insulin and NEFA concentrations are elevated (5,21) and conversely sympathetic activation may lead to insulin resistance (1-4). Infusions of norepinephrine lead to rapid increments in NEFA flux and levels (22,23) and raised arterial norepinephrine concentration and greater SNS activity have been reported in overweight subjects with MetS (24).

In a series of studies describing the effects of energy expenditure through reduced food intake with or without exercise, Straznicky et al (4,8,9) have shown the importance in obesity of hyperinsulinemia driving sympathetic nerve activity both of which declined in tandem with weight loss. Arterial norepinephrine was inversely associated with the metabolic clearance of insulin in insulin resistant subjects (7). Vaz et al have demonstrated a key neural mechanism, that of increased renal norepinephrine spillover in obese subjects (25).

The close relationship between plasma NEFA concentration and adiposity is well recognised and is reflected in the significant partial correlation between NEFA and BMI reported here. Sympathetic nervous system activity is known to rise with age as demonstrated by the significant partial coefficient between age and logNE. Evidence for an association between heart rate and MetS is emerging and may explain the significant partial correlation between HOMA and HR. Two recent reports of studies in large populations, a cross-sectional study in Israel (26) and a longitudinal study in China (27) have shown clear links between elevated heart rate and presence of MetS as well as predicting future development of the syndrome. Our data are consistent with those observations (Table 2).

The pathophysiological processes that link tissue sphingolipids, partly defined by their concentrations in plasma, to type 2 diabetes and MetS are under intense investigation. Sphingolipids integrate within membrane microdomains or lipid rafts that influence membrane structure and function through lipid-protein interactions that regulate membrane trafficking, signal transduction and receptor functions (16). Both ceramide and sphingomyelin that can interconvert, as well as ganglioside GM3 that can also generate ceramide are thus integral to ceramide-rich platforms (16). Sphingolipids and ceramides in particular mediate loss of insulin sensitivity through actions in insulin sensitive tissues affected in MetS and diabetes (12). The significant associations between the parameters of SNS activity and plasma free cholesterol concentration may also relate to the critical function of free cholesterol in membrane microdomains.

Plasma sphingolipid levels have become recognized as potential biomarkers of insulin resistance. Haus et al (10) have reported elevated concentrations of ceramides in obese subjects with type 2 diabetes that correlated with severity of insulin resistance. In several large prospective studies involving over one thousand subjects with pre-diabetes or type 2 diabetes, Meikle et al reported positive associations between those disorders and circulating ceramides, phosphatidylethanolamine, phosphatidylinositol and phosphatidylglycerol and inverse associations with alkyl- and alkenylphosphatidylcholine (15). In obese women the fasting plasma insulin concentration was found to be positively correlated with phospholipids sphingomyelin, phosphatidiylcholine and phosphatidylethanolamine in adipocytes and erythrocytes harvested from the subjects (13,28). Erythrocyte membrane sphingomyelin content was found to be independently associated with parameters of insulin resistance in obese non-diabetic women (28). Similar phospholipid classes (13) were found to be associated in our current study with plasma norepinephrine and NEFA concentrations (Tables 3 and 4). The data on the reference cohort of 40 healthy subjects of similar age to those with MetS but displaying none of the characteristics of MetS have been provided to demonstrate that the lipidomic profile in the MetS group differed significantly from a healthy cohort with respect to ceramide species, sphingomyelin, alkyl- and alkenylphosphatidylcholine and lysophosphatidylcholine, (as well as the corresponding phosphatidyletahanolamine species), (Supplementary Tables 3, 4 and 5). Since that was the extent of the importance of including the healthy reference cohort we did not measure biomarkers of SNS activity or IR in this group although we have reported elsewhere significantly higher SNS activity in MetS than in lean healthy subjects, measured by muscle sympathetic nerve activity or microneurography (29). We have also reported elsewhere in a cohort of subjects with IR significant direct correlations between plasma NEFA and arterial NE as well as with muscle sympathetic nerve activity (30). Heart rate was found to be directly associated with another marker of SNS activity, neuronal reuptake of NE measured in vivo.

We have also reported in obese subjects with metabolic syndrome significant negative associations between indices of insulin resistance (fasting insulin, HOMA-IR and insulin $AUC_{0\text{-}120\ min}$ after glucose

ingestion) and plasma lysophosphatidylcholine and lyso-platelet-activating-factor (lysoalkylphosphatidylcholine) and positive association with Matsuda index (31). Lysophosphatidylcholine which is diminished in plasmas of obese and type 2 diabetic subjects (14), stimulates glucose transporter GLUT 4 and glucose uptake in adipocytes (32) whereas ceramide inhibits GLUT 4 expression (33). Mice carrying a deletion of GM3 ganglioside synthase show improved insulin sensitivity in muscle (34). The multitude of effects of sphingolipids on insulin sensitivity and glucose transport has been reviewed recently by Larsen and Tennagels (12). In the present study several parameters of IR (BMI, HOMA-IR, fasting plasma insulin and Matsuda index) were found to associate with several of the above lipids when adjusted for age and sex only but not when corrected for multiple comparisons of lipids (data not shown).

Sphingolipids have shown associations with cardiovascular diseases including atherosclerosis. In patients with acute coronary syndrome or stable coronary heart disease, plasma ceramide levels were significantly associated with vulnerable atherosclerotic plaques identified by intravascular ultrasound visual histology (35). A lipidomic study of plasma high density lipoprotein (HDL) showed an inverse association between the plasmalogen content in HDL and coronary heart disease (36). In subjects with low HDL cholesterol concentrations, the sphingomyelin and lysophosphatidylcholine content in HDL was diminished (37). Stahlman et al have reported in type 2 diabetic patients dysfunctional HDL enriched in lysophosphatidylcholine and in the small dysfunctional HDL increased ceramides and subnormal amount of plasmalogen per particle consistent with increased oxidative stress (38). Elevated plasma sphingomyelin concentrations have been reported in patients with coronary heart disease (39). Of greater relevance, Stegemann have reported improved future cardiovascular disease prediction in a healthy prospective cohort by incorporating six lipid species including sphingomyelin, phosphatidylethanolamine and lysophosphatidylcholine into the traditional Framingham risk score (40).

374 Ceramides are also involved in cytokine mediated inflammatory processes; their roles in
375 physiological and pathological processes in the nervous system have been reviewed recently by
376 Shamim et al (41). Sphingolipids are major structural components of the nervous system involved in
377 myelination of axons, cell-cell interactions and signalling processes. To what extent these functions
378 may operate within the SNS requires further investigation.

379 The present study would appear to be the first to have shown strong associations between arterial
380 norepinephrine and plasma NEFA concentrations and a number of complex lipid classes. Although
381 several of these lipid classes and ceramides in particular, as well as norepinephrine and NEFA
382 concentrations are associated in common with factors affecting IR and MetS, the correlations of
383 norepinephrine and NEFA with lipid classes/subclasses were independent of biomarkers of MetS and
384 IR. That leads to seeking alternative or additional explanations such as the possibility of a common
385 link with SNS activity.

386 Limitations include the relatively large numbers of lipid classes/subclasses studied although
387 statistical corrections for multiple comparisons were made. Secondly, the cross-sectional nature of
388 the analysis precludes causality. Finally, although the 94 subjects were relatively homogeneous in
389 sharing parameters of MetS and being untreated, the current findings would apply to such a
390 population. Our hypothesis that the underlying associations reflect changes in the sympathetic
391 nervous system that increase cardiometabolic risk awaits more robust supportive biological
392 evidence.

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527 **Table 1: Demographic and clinical characteristics of study participants**

Variable	Mean ± SD (N=94)
Age (yr)	55.5 ± 5.6
Gender (M:F)	56 : 38
Body weight (kg)	97.4 ± 15.5
Body mass index (kg/m^2)	32.9 ± 4.0
Waist circumference (cm)	107.3 ± 10.7
Systolic blood pressure (mmHg)	136 ± 16
Diastolic blood pressure (mmHg)	77 ± 8
Heart rate (bpm)	67 ± 11
Arterial norepinephrine (pg/ml)	225 ± 109
Total cholesterol (mmol/L)	5.6 ± 0.9
LDL-cholesterol (mmol/L)	3.5 ± 0.8
HDL-cholesterol (mmol/L)	1.2 ± 0.3
Triacylglycerol (mmol/L)	1.8 ± 1.1
NEFA (mEq/L)	0.54 ± 0.18
Fasting glucose (mmol/L)	5.9 ± 0.7
Fasting insulin (mU/L)	18.5 ± 5.8
HOMA-IR	4.9 ± 1.6
Insulin $AUC_{0\text{-}120}$ (mU · min · L^{-1})	10,569 ± 3941
Matsuda ISI	2.11 ± 0.81

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Table 2: Significant associations among relevant covariates

Predictor[a]	Outcome	*β*-Coefficient (95%CI)[b]	*p*-value[c]
HOMA-IR[d]	BMI (kg/m2)	1.25 (0.12 - 2.39)	0.03
Fasting insulin (mU/L)[d]	BMI (kg/m2)	1.18 (0.08 - 2.27)	0.03
Matsuda (SI)[d]	BMI (kg/m2)	-0.88 (-1.68 - -0.08)	0.03
BMI (kg/m2)[d]	HOMA-IR (units)	0.46 (0.04 - 0.87)	0.03
Fasting glucose (mmol/L)[d]	HOMA-IR (units)	0.56 (0.26 - 0.86)	<0.01
Fasting insulin (mU/L)[d]	HOMA-IR (units)	2.14 (1.99 - 2.29)	<0.01
Matsuda (SI)[d]	HOMA-IR (units)	-1.29 (-1.5 - -1.09)	<0.01
HOMA-IR (units)[d]	HR (bpm)	3.41 (0.95 - 5.88)	0.01
Fasting insulin (mU/L)[d]	HR (bpm)	3.14 (0.77 - 5.51)	0.01
Matsuda[d]	HR (bpm)	-1.94 (-3.69 - -0.2)	0.03
BMI (kg/m2)[d]	NEFA (mEq/L)	0.053 (0.016 - 0.091)	0.01
HDL-C (mmol/L)[d]	NEFA (mEq/L)	0.069 (0.017 - 0.122)	0.01
Matsuda (SI)[d]	NEFA (mEq/L)	-0.034 (-0.065 - -0.003)	0.03
Glucose au120[e]	NEFA (mEq/L)	0.043 (0.004 - 0.082)	0.03
Triacylglycerol (mmol/L)[e]	NEFA (mEq/L)	0.031 (0.004 - 0.058)	0.02
Fasting insulin (mU/L)[f]	NE (pg/ml)	98.6 (5.7 - 191.5)	0.04

[a] *Homeostatic model assessment-estimated insulin resistance (HOMA-IR); Body mass index (BMI); Systolic blood pressure (SBP); High-density lipoprotein-cholesterol (HDL-C); Heart rate (HR); Non-esterified fatty acids (NEFA); Norepinephrine (NE)*

[b] *Beta coefficient (95% confidence intervals) of linear regression analysis based on an interquartile range increases in the predictor measurement against the outcome.*

[c] *p-values corrected for multiple comparisons using the Benjamini-Hochberg method, p<0.05 were considered as significant.*

[d] *Adjusted for age and sex.*

[e] *Adjusted for age, sex, BMI, SBP and HDL-C.*

[f] *Adjusted for age, sex, BMI, SBP and HOMA-IR.*

Table 3: Linear regression analysis of plasma lipid classes/subclasses against log-norepinephrine in MetS

Lipid class/subclass [a]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*Corrected p*-value [d]
Dihydroceramide	0.066 (0.018-0.115)	**0.01**	**0.03**
Ceramide	0.079 (0.027-0.131)	**<0.01**	**0.02**
Monohexocylceramide	0.049 (-0.004-0.101)	0.07	0.14
Dihexosylceramide	0.063 (0.015-0.111)	**0.01**	**0.04**
Trihexosylceramide	0.059 (0.005-0.114)	**0.04**	0.09
GM3 ganglioside	0.025 (-0.028-0.078)	0.35	0.48
Sphingomyelin	0.070 (0.020-0.119)	**0.01**	**0.03**
Phosphatidylcholine	0.063 (0.011-0.115)	**0.02**	0.06
Alkylphosphatidylcholine	0.103 (0.051-0.155)	**<0.01**	**0.01**
Alkenylphosphatidylcholine	0.094 (0.035-0.152)	**<0.01**	**0.02**
Lysophosphatidylcholine	0.027 (-0.028-0.082)	0.33	0.48
Lysoalkylphosphatidylcholine	0.026 (-0.022-0.074)	0.29	0.44
Phosphatidylethanolamine	-0.014 (-0.068-0.040)	0.61	0.70
Alkylphosphatidylethanolamine	0.043 (-0.004-0.091)	0.08	0.14
Alkenylphosphatidylethanolamine	0.049 (-0.005-0.102)	0.08	0.14
Lysophosphatidylethanolamine	0.019 (-0.035-0.073)	0.49	0.60
Phosphatidylinositol	0.031 (-0.021-0.082)	0.25	0.40
Lysophosphatidylinositol	0.058 (-0.002-0.118)	0.06	0.14
Phosphatidylglycerol	0.001 (-0.049-0.050)	0.98	0.98
Free cholesterol	0.078 (0.030-0.127)	**<0.01**	**0.02**
Cholesteryl ester	0.021 (-0.034-0.077)	0.45	0.58

Diacylglycerol	0.010 (-0.047-0.066)	0.74	0.81
Triacylglycerol	0.007 (-0.042-0.056)	0.79	0.82

542 *[a] Lipid class/subclass represents the sum of the individual lipid species within that class.*

543 *[b] Beta coefficient (95% confidence intervals) based on an interquartile range increases in predictor*

544 *lipid classes measurement, adjusting for age, sex, body mass index (BMI), systolic blood pressure*

545 *(SBP) and Homeostatic model assessment-estimated insulin resistance (HOMA-IR).*

546 *[c] p-values not corrected for multiple comparisons.*

547 *[d] p-values corrected for multiple comparisons using the method of Benjamini Hochberg.*

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549 **Table 4: Linear regression analysis of plasma lipid classes/subclasses against NEFA in MetS**

Lipid class/subclass [a]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*Corrected p*-value [d]
Dihydroceramide	0.021 (-0.017 - 0.06)	0.29	0.42
Ceramide	0.03 (-0.011 - 0.071)	0.15	0.25
Monohexocylceramide	0.045 (0.007 - 0.083)	**0.02**	**0.05**
Dihexosylceramide	0.054 (0.019 - 0.088)	**<0.01**	**0.02**
Trihexosylceramide	0.054 (0.012 - 0.095)	**0.01**	**0.05**
GM3 ganglioside	0.069 (0.033 - 0.106)	**<0.01**	**0.01**
Sphingomyelin	0.048 (0.008 - 0.088)	**0.02**	**0.05**
Phosphatidylcholine	0.061 (0.021 - 0.1)	**<0.01**	**0.02**
Alkylphosphatidylcholine	0.055 (0.014 - 0.095)	**0.01**	**0.04**
Alkenylphosphatidylcholine	0.051 (0.008 - 0.094)	**0.02**	**0.05**
Lysophosphatidylcholine	0.022 (-0.023 - 0.066)	0.34	0.44
Lysoalkylphosphatidylcholine	0.003 (-0.035 - 0.04)	0.89	0.89
Phosphatidylethanolamine	0.022 (-0.021 - 0.066)	0.32	0.43
Alkylphosphatidylethanolamine	-0.006 (-0.044 - 0.031)	0.74	0.81
Alkenylphosphatidylethanolamine	0.01 (-0.032 - 0.052)	0.64	0.73
Lysophosphatidylethanolamine	0.034 (-0.008 - 0.077)	0.12	0.23
Phosphatidylinositol	0.061 (0.022 - 0.1)	**<0.01**	**0.02**
Lysophosphatidylinositol	0.05 (0.005 - 0.096)	**0.03**	0.07
Phosphatidylglycerol	0.013 (-0.026 - 0.052)	0.53	0.64
Free cholesterol	0.047 (0.008 - 0.085)	**0.02**	**0.05**
Cholesteryl ester	0.033 (-0.012 - 0.077)	0.15	0.25
Diacylglycerol	0.024 (-0.02 - 0.067)	0.29	0.42

Triacylglycerol	0.006 (-0.033 - 0.044)	0.77	0.81

[a] *Lipid class/subclass represents the sum of the individual lipid species within that class/subclass.*

[b] *Beta coefficient (95% confidence intervals) based on an interquartile range increases in predictor lipid classes measurement, adjusting for age, sex, body mass index (BMI), systolic blood pressure (SBP) and Homeostatic model assessment-estimated insulin resistance (HOMA-IR).*

[c] *p-values not corrected for multiple comparisons.*

[d] *p-values corrected for multiple comparisons using the method of Benjamini Hochberg.*

Table 5: Linear regression analysis of plasma lipid classes/subclasses against heart rate in MetS

Lipid class/subclass [a]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*Corrected p*-value [d]
Dihydroceramide	2.32 (0.16 - 4.48)	0.08	0.14
Ceramide	2.65 (0.41 - 4.88)	**0.02**	0.10
Monohexocylceramide	2.09 (-0.12 - 4.3)	0.07	0.14
Dihexosylceramide	2.09 (0.06 - 4.11)	0.05	0.14
Trihexosylceramide	0.38 (-2.08 - 2.85)	0.82	0.82
GM3 ganglioside	2.85 (0.7 - 4.99)	**0.01**	0.09
Sphingomyelin	3.13 (0.92 - 5.33)	**0.01**	0.07
Phosphatidylcholine	2.28 (-0.03 - 4.6)	0.06	0.14
Alkylphosphatidylcholine	2.07 (-0.29 - 4.43)	0.08	0.14
Alkenylphosphatidylcholine	1.51 (-1 - 4.02)	0.29	0.34
Lysophosphatidylcholine	2.67 (0.18 - 5.15)	**0.02**	0.10
Lysoalkylphosphatidylcholine	1.47 (-0.63 - 3.57)	0.138	0.19
Phosphatidylethanolamine	0.31 (-2.18 - 2.81)	0.56	0.58
Alkylphosphatidylethanolamine	1.63 (-0.48 - 3.73)	0.24	0.29
Alkenylphosphatidylethanolamine	2.42 (0.1 - 4.74)	0.05	0.14
Lysophosphatidylethanolamine	1.64 (-0.72 - 4.01)	0.12	0.19
Phosphatidylinositol	3.07 (0.83 - 5.31)	**0.01**	0.07
Lysophosphatidylinositol	3.5 (0.89 - 6.12)	**0.01**	0.07
Phosphatidylglycerol	0.47 (-1.61 - 2.56)	0.47	0.51
Free cholesterol	2.36 (0.14 - 4.57)	**0.03**	0.10
Cholesteryl ester	2.11 (-0.51 - 4.73)	0.08	0.14
Diacylglycerol	1.89 (-0.56 - 4.34)	0.14	0.19
Triacylglycerol	1.17 (-0.9 - 3.25)	0.19	0.25

[a] *Lipid class/subclass represents the sum of the individual lipid species within that class/subclass.*

[b] *Beta coefficient (95% confidence intervals) based on an interquartile range increases in predictor lipid classes measurement, adjusting for age, sex, body mass index (BMI), systolic blood pressure (SBP) and Homeostatic model assessment-estimated insulin resistance (HOMA-IR).*

[c] *p-values not corrected for multiple comparisons.*

[d] *p-values corrected for multiple comparisons using the method of Benjamini Hochberg.*

Supplementary Material

Lipidomic Analysis

Lipids were extracted from plasma samples using a single phase chloroform/methanol extraction process, incorporating an internal standard mix containing stable-isotope labelled and non-physiological standards (Supplementary Table 1), as described previously (1).

Briefly, plasma samples (10 µL) were aliquoted into a 1.5 mL eppendorf tubes together with 10 µL of an internal standard mix containing stable-isotope labelled and non-physiological standards (Supplementary Table 1) and 200 µL chloroform:methanol (2:1) was added. Samples were mixed (10 min), sonicated in a water bath (30 min, 18°C-24°C), allowed to stand at room temperature for 30 min and then centrifuged (16,000xg, 10 min, 20°C). The supernatants were dried in a speedy Vac (Savant RVT5105, Thermo Scientific, USA) then samples were reconstituted in 50 µL water saturated butanol (1:1, v/v) and 50 µL methanol containing ammonium formate (10 mmol/L) with sonication (10 min). Samples were then centrifuged (1,711 xg, 5 min, 20°C) and the supernatants were transferred into a 0.2 mL glass vials with teflon insert caps.

Lipidomic analyses was performed by electrospray ionization tandem mass spectrometry with the use of an Agilent 1290 liquid chromatography system combined with an 6490 triple quadrupole mass spectrometer with a turbo-ionspray source (200°C) (Agilent Technologies, Singapore). A total of 339 lipid species from 23 classes/subclasses were measured. Liquid chromatography was performed on a Zorbax Eclipse Plus C18, 2.1 x 50mm, 1.8-Micron column (Agilent Technologies, USA). Solvent A and B consisted of (tetrahydrofuran:methanol:water) in ratios of (20:20:60) and (75:20:5) respectively, both containing 10 mmol/L ammonium formate. The temperature of column and the auto-sampler were regulated to 50 and 25° C, respectively. The following gradient conditions were used: (400 µL/min) 0% B to 40% B over 2 min, 40% B to 100% B over 6.5 min, 0.5 min at 100% B and a return to 0% solvent B over 0.5 min then 0.2 min at 0% solvent B prior to the next injection.

Lipid species were measured using a modification of our previously reported scheduled multiple reaction monitoring (sMRM) methodology (1). The scheduled MRM experiment conditions of each lipid class/subclass are provided in Supplementary Table 1. The sMRM transitions were identified based on known m/z values of the parent ions and product ions as well as the relative elution times of each lipid species and are shown in Supplementary Table 2. The integration of chromatographic peaks was performed on the MassHunter Workstation Software (Agilent Technologies, USA). The concentration of each lipid species was calculated by relating the peak area of each lipid species to the peak area of the corresponding internal standard. The concentrations of each lipid class/subclass were calculated by summing the lipid species within each class/subclass. The relative concentration of plasma lipids were expressed in pmol/mL. We recognise the limitations of lipidomic measurements to provide accurate quantification of many hundreds of individual lipid species with the relatively few internal standards currently available; we report relative concentrations as an indication only.

A plasma quality control sample (pooled plasma from six healthy individuals) as well as blank samples (no plasma) were analysed for each 20 participant samples to monitor assay performance.

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Supplementary Table 1: Conditions for tandem mass spectrometry analysis of lipid classes

Lipid class/subclass	Parent Ion	Fragmentation[a]	Number of features	Internal standard	Internal standard (pmol)	Collision Energy (V)	Cell Accelerator Voltage (V)
Dihydrocer amide (Cer(d18:0))	$[M+H]^+$	NL, 18 Da	6	Cer(d18:0/8:0)	50	21	5
Ceramide (Cer(d18:1))	$[M+H]^+$	PI, m/z 264.3	6	Cer(d18:1/17:0)	100	29	5
Monohexocylceramide (HexCer)	$[M+H]^+$	PI, m/z 264.3	6	Glucosylceramide 16:0 d3	50	33	5
Dihexosylceramide (Hex2Cer)	$[M+H]^+$	PI, m/z 264.3	6	Lactosylceramide 16:0 d3	50	53	5
Trihexosylceramide (Hex3Cer)	$[M+H]^+$	PI, m/z 264.3	6	Hex3Cer(17:0)	50	57	5
GM3 ganglioside (GM3)	$[M+H]^+$	PI, m/z 264.3	6	Hex3Cer(17:0)	50	57	5
Sphingomyelin (SM)	$[M+H]^+$	PI, m/z 184.1	21	SM(d18:1/12:0)	200	25	5
Phosphatidylcholine (PC)	$[M+H]^+$	PI, m/z 184.1	48	PC(13:0/13:0)	100	21	5
Alkylphosphatidylcholine (PC(O))	$[M+H]^+$	PI, m/z 184.1	19	PC(13:0/13:0)	100	21	5
Alkenylphosphatidylcholine (PC(P))	$[M+H]^+$	PI, m/z 184.1	14	PC(13:0/13:0)	100	21	5
Lysophosphatidylcholine (LPC)	$[M+H]^+$	PI, m/z 184.1	22	LPC(13:0)	100	21	5
Lysoalkylphosphatidylcholine (LPC(O))	$[M+H]^+$	PI, m/z 104.1	10	LPC(13:0)	100	21	5
Phosphatidylethanolamine (PE)	$[M+H]^+$	NL, 141 Da	21	PE(17:0/17:0)	100	17	5
Alkylphosphatidylethanolamine (PE(O))	$[M+H]^+$	NL, 141 Da	12	PE(17:0/17:0)	100	17	5
Alkenylphosphatidylethanolamine (PE(P))	$[M+H]^+$	NL, 141 Da	11	PE(17:0/17:0)	100	17	5
Lysophosphatidylethanolamine (LPE)	$[M+H]^+$	NL, 141 Da	6	LPE(14:0)	100	17	5
Phosphatidylinositol (PI)	$[M+NH_4]^+$	NL, 277 Da	16	PE(17:0/17:0)	100	17	5
Lysophosphatidylinositol (LPI)	$[M+NH_4]^+$	NL, 277 Da	4	PE(17:0/17:0)	100	17	5
Phosphatidylglycerol (PG)	$[M+NH_4]^+$	NL, 189 Da	3	PG(17:0/17:0)	100	21	5
Free cholesterol (COH)	$[M-H_2O]^+$	PI, m/z 161.2	1	COH-d7	10000	23	5
Cholesteryl ester (CE)	$[M+NH_4]^+$	PI, m/z 369.3	26	CE(18:0) d6	1000	10	5
Diacylglycerol (DG)	$[M+NH_4]^+$	NL, NH_3 + fatty acid	25	DG(15:0/15:0)	200	21	5
Triacylglycerol (TG)	$[M+NH_4]^+$	NL, NH_3 + fatty acid	44	TG(17:0/17:0/17:0)	100	21	5

[a] PI, product ion; NL, neutral loss; SIM, single ion monitoring.

Supplementary Table 2: Conditions for tandem mass spectrometry analysis of lipid species

Lipid [a]	Parent ion (m/z)	Product ion (m/z)	Retention time (min)	Correction factor[b]	% CV[c]
Cer(d18:0/16:0)	540.5	522.5	5.72	1.00	9
Cer(d18:0/18:0)	568.6	550.6	6.04	1.00	10
Cer(d18:0/20:0)	596.6	578.6	6.33	1.00	10
Cer(d18:0/22:0)	624.6	606.6	6.60	1.00	8
Cer(d18:0/24:0)	652.7	634.7	6.83	1.00	7
Cer(d18:0/24:1)	650.6	632.6	6.74	1.00	8
Cer(d18:1/16:0)	538.5	264.3	5.59	1.00	10
Cer(d18:1/18:0)	566.6	264.3	5.92	1.00	14
Cer(d18:1/20:0)	594.6	264.3	6.23	1.00	17
Cer(d18:1/22:0)	622.6	264.3	6.50	1.00	10
Cer(d18:1/24:0)	650.6	264.3	6.74	1.00	8
Cer(d18:1/24:1)	648.6	264.3	6.51	1.00	5
HexCer(d18:1/16:0)	700.6	264.3	4.90	1.00	10
HexCer(d18:1/18:0)	728.6	264.3	5.26	1.00	16
HexCer(d18:1/20:0)	756.6	264.3	5.60	1.00	20
HexCer(d18:1/22:0)	784.7	264.3	5.90	1.00	18
HexCer(d18:1/24:0)	812.7	264.3	6.19	1.00	20
HexCer(d18:1/24:1)	810.7	264.3	5.91	1.00	17
Hex2Cer(d18:1/16:0)	862.6	264.3	4.59	1.00	12
Hex2Cer(d18:1/18:0)	890.7	264.3	4.95	1.00	37
Hex2Cer(d18:1/20:0)	918.7	264.3	5.31	1.00	18
Hex2Cer(d18:1/22:0)	946.7	264.3	5.62	1.00	12
Hex2Cer(d18:1/24:0)	974.8	264.3	5.91	1.00	14
Hex2Cer(d18:1/24:1)	972.7	264.3	5.63	1.00	15
Hex3Cer(d18:1/16:0)	1024.7	264.3	4.40	1.00	19
Hex3Cer(d18:1/18:0)	1052.7	264.3	4.76	1.00	25
Hex3Cer(d18:1/20:0)	1080.7	264.3	5.11	1.00	19
Hex3Cer(d18:1/22:0)	1108.8	264.3	5.44	1.00	14
Hex3Cer(d18:1/24:0)	1136.8	264.3	5.74	1.00	11
Hex3Cer(d18:1/24:1)	1134.8	264.3	5.45	1.00	12
GM3(d18:1/16:0)	1153.7	264.3	3.54	1.00	10
GM3(d18:1/18:0)	1181.8	264.3	3.93	1.00	9
GM3(d18:1/20:0)	1209.8	264.3	4.29	1.00	12
GM3(d18:1/22:0)	1237.8	264.3	4.59	1.00	10
GM3(d18:1/24:0)	1265.8	264.3	4.91	1.00	16
GM3(d18:1/24:1)	1263.8	264.3	4.61	1.00	8
SM(31:1)	661.5	184.1	3.71	1.00	3
SM(32:0)	677.6	184.1	4.08	1.00	12
SM(32:1)	675.5	184.1	3.93	1.00	3
SM(32:2)	673.5	184.1	3.62	1.00	3
SM(33:1)	689.6	184.1	4.12	1.00	3
SM(34:0)	705.6	184.1	4.46	1.00	8
SM(34:1)	703.6	184.1	4.31	1.00	4
SM(34:2)	701.6	184.1	4.05	1.00	4

Lipid [a]	Parent ion (m/z)	Product ion (m/z)	Retention time (min)	Correction factor[b]	% CV[c]
SM(34:3)	699.5	184.1	3.81	1.00	4
SM(35:1)	717.6	184.1	4.51	1.00	6
SM(35:2)	715.6	184.1	4.26	1.00	6
SM(36:1)	731.6	184.1	4.71	1.00	14
SM(36:2)	729.6	184.1	4.46	1.00	6
SM(36:3)	727.6	184.1	4.21	1.00	5
SM(37:2)	743.5	184.1	4.68	1.00	5
SM(38:1)	759.6	184.1	5.09	1.00	7
SM(38:2)	757.6	184.1	4.86	1.00	7
SM(39:1)	773.7	184.1	5.25	1.00	6
SM(41:1)	801.7	184.1	5.58	1.00	8
SM(41:2)	799.7	184.1	5.34	1.00	5
SM(42:1)	816.7	184.1	5.73	1.00	5
PC(28:0)	678.5	184.1	4.23	1.00	10
PC(29:0)	692.5	184.1	4.77	1.00	3
PC(30:0)	706.5	184.1	4.63	1.00	4
PC(31:0)	720.6	184.1	4.80	1.00	5
PC(31:1)	718.5	184.1	4.51	1.00	5
PC(32:0)	734.6	184.1	4.99	1.00	4
PC(32:1)	732.6	184.1	4.74	1.00	6
PC(32:2)	730.5	184.1	4.48	1.00	6
PC(32:3)	728.5	184.1	4.28	1.00	6
PC(33:0)	748.6	184.1	5.12	1.00	4
PC(33:1)	746.6	184.1	4.92	1.00	4
PC(33:2)	744.6	184.1	4.68	1.00	7
PC(33:3)	742.5	184.1	4.48	1.00	4
PC(34:0)	762.6	184.1	5.35	1.00	5
PC(34:1)	760.6	184.1	5.09	1.00	9
PC(34:2)	758.6	184.1	4.86	1.00	6
PC(34:3)	756.6	184.1	4.66	1.00	8
PC(34:4)	754.5	184.1	4.51	1.00	9
PC(34:5)	752.5	184.1	4.31	1.00	4
PC(35:0)	776.6	184.1	5.44	1.00	6
PC(35:1)	774.6	184.1	5.25	1.00	6
PC(35:2)	772.6	184.1	5.03	1.00	7
PC(35:3)	770.6	184.1	4.83	1.00	5
PC(35:4)	768.6	184.1	4.70	1.00	4
PC(36:0)	790.6	184.1	5.67	1.00	6
PC(36:1)	788.6	184.1	5.42	1.00	6
PC(36:2)	786.6	184.1	5.22	1.00	5
PC(36:3)	784.6	184.1	5.05	1.00	5
PC(36:4)	782.6	184.1	4.85	1.00	5
PC(36:5)	780.6	184.1	4.69	1.00	9
PC(36:6)	778.5	184.1	4.50	1.00	16
PC(37:4)	796.6	184.1	5.06	1.00	5

Lipid [a]	Parent ion (m/z)	Product ion (m/z)	Retention time (min)	Correction factor[b]	% CV[c]
PC(37:5)	794.6	184.1	4.85	1.00	7
PC(37:6)	792.6	184.1	4.69	1.00	3
PC(38:2)	814.6	184.1	5.62	1.00	4
PC(38:3)	812.6	184.1	5.34	1.00	6
PC(38:4)	810.6	184.1	5.25	1.00	7
PC(38:5)	808.6	184.1	4.97	1.00	7
PC(38:6)	806.6	184.1	4.87	1.00	5
PC(38:7)	804.6	184.1	4.87	1.00	6
PC(39:5)	822.6	184.1	5.13	1.00	4
PC(39:6)	820.6	184.1	5.05	1.00	5
PC(39:7)	818.6	184.1	4.84	1.00	10
PC(40:4)	838.6	184.1	5.55	1.00	3
PC(40:5)	836.6	184.1	5.29	1.00	5
PC(40:6)	834.6	184.1	5.21	1.00	6
PC(40:7)	832.6	184.1	4.95	1.00	8
PC(40:8)	830.6	184.1	4.73	1.00	5
PC(O-32:0)	720.6	184.1	5.12	1.00	9
PC(O-32:1)	718.5	184.1	4.89	1.00	8
PC(O-32:2)	716.6	184.1	4.63	1.00	12
PC(O-34:1)	746.6	184.1	5.20	1.00	6
PC(O-34:2)	744.6	184.1	5.00	1.00	7
PC(O-34:3)	742.5	184.1	4.50	1.00	8
PC(O-34:4)	740.6	184.1	4.78	1.00	9
PC(O-35:4)	754.5	184.1	4.66	1.00	7
PC(O-36:0)	776.6	184.1	5.80	1.00	8
PC(O-36:1)	774.6	184.1	5.56	1.00	8
PC(O-36:2)	772.6	184.1	5.35	1.00	6
PC(O-36:3)	770.6	184.1	5.03	1.00	5
PC(O-36:4)	768.6	184.1	5.02	1.00	5
PC(O-36:5)	766.6	184.1	4.83	1.00	5
PC(O-38:4)	796.6	184.1	5.38	1.00	7
PC(O-38:5)	794.6	184.1	5.10	1.00	4
PC(O-40:5)	822.6	184.1	5.41	1.00	8
PC(O-40:6)	820.6	184.1	5.36	1.00	6
PC(O-40:7)	818.6	184.1	5.08	1.00	6
PC(P-30:0)	690.4	184.1	4.76	1.00	9
PC(P-32:0)	718.5	184.1	5.11	1.00	7
PC(P-32:1)	716.6	184.1	5.11	1.00	10
PC(P-34:1)	744.6	184.1	5.20	1.00	5
PC(P-34:2)	742.5	184.1	4.97	1.00	6
PC(P-34:3)	740.6	184.1	4.97	1.00	9
PC(P-36:2)	770.6	184.1	5.32	1.00	7
PC(P-36:4)	766.6	184.1	5.00	1.00	6
PC(P-36:5)	764.6	184.1	4.79	1.00	7
PC(P-38:4)	794.6	184.1	5.33	1.00	6

Lipid [a]	Parent ion (m/z)	Product ion (m/z)	Retention time (min)	Correction factor[b]	% CV[c]
PC(P-38:5)	792.6	184.1	5.05	1.00	9
PC(P-38:6)	790.6	184.1	4.94	1.00	5
PC(P-40:5)	820.6	184.1	5.15	1.00	9
PC(P-40:6)	818.6	184.1	5.31	1.00	5
LPC(14:0)	468.3	184.1	2.08	1.00	3
LPC(15:0)	482.3	184.1	2.28	1.00	4
LPC(16:0)	496.3	184.1	2.48	1.00	3
LPC(16:1)	494.3	184.1	2.23	1.00	3
LPC(17:0)	510.4	184.1	2.64	1.00	4
LPC(17:1)	508.4	184.1	2.41	1.00	3
LPC(18:0)	524.4	184.1	2.83	1.00	4
LPC(18:1)	522.4	184.1	2.58	1.00	4
LPC(18:2)	520.3	184.1	2.38	1.00	6
LPC(18:3)	518.3	184.1	2.20	1.00	4
LPC(20:0)	552.4	184.1	3.19	1.00	5
LPC(20:1)	550.4	184.1	2.91	1.00	5
LPC(20:2)	548.4	184.1	2.69	1.00	10
LPC(20:3)	546.4	184.1	2.53	1.00	9
LPC(20:4)	544.3	184.1	2.40	1.00	7
LPC(20:5)	542.3	184.1	2.22	1.00	7
LPC(22:0)	580.4	184.1	3.65	1.00	7
LPC(22:1)	578.4	184.1	3.25	1.00	12
LPC(22:5)	570.4	184.1	2.51	1.00	8
LPC(22:6)	568.3	184.1	2.41	1.00	9
LPC(24:0)	608.5	184.1	4.12	1.00	7
LPC(26:0)	636.5	184.1	4.45	1.00	20
LPC(O-16:0)	482.4	104.1	2.56	1.00	5
LPC(O-18:0)	510.4	104.1	2.93	1.00	5
LPC(O-18:1)	508.4	104.1	2.65	1.00	3
LPC(O-20:0)	538.4	104.1	3.01	1.00	2
LPC(O-20:1)	536.4	104.1	2.73	1.00	8
LPC(O-22:0)	566.5	104.1	3.78	1.00	4
LPC(O-22:1)	564.4	104.1	3.36	1.00	8
LPC(O-24:0)	594.5	104.1	4.23	1.00	6
LPC(O-24:1)	592.5	104.1	3.82	1.00	6
LPC(O-24:2)	590.5	104.1	3.52	1.00	9
PE(32:0)	692.5	551.5	5.14	1.00	18
PE(32:1)	690.5	549.5	4.90	1.00	17
PE(34:1)	718.5	577.5	5.24	1.00	8
PE(34:2)	716.5	575.5	5.01	1.00	8
PE(34:3)	714.5	573.5	4.80	1.00	13
PE(35:1)	732.6	591.5	5.40	1.00	15
PE(35:2)	730.5	589.5	5.17	1.00	16
PE(36:0)	748.6	607.6	5.78	1.00	29
PE(36:1)	746.6	605.6	5.55	1.00	11

Lipid [a]	Parent ion (m/z)	Product ion (m/z)	Retention time (min)	Correction factor[b]	% CV[c]
PE(36:2)	744.6	603.5	5.37	1.00	8
PE(36:3)	742.5	601.5	5.12	1.00	10
PE(36:4)	740.5	599.5	5.04	1.00	8
PE(36:5)	738.5	597.5	4.83	1.00	15
PE(38:3)	770.6	629.6	5.47	1.00	10
PE(38:4)	768.6	627.5	5.38	1.00	9
PE(38:5)	766.5	625.5	5.12	1.00	7
PE(38:6)	764.5	623.5	5.02	1.00	7
PE(40:4)	796.6	655.6	5.59	1.00	13
PE(40:5)	794.6	653.6	5.53	1.00	11
PE(40:6)	792.6	651.5	5.36	1.00	10
PE(40:7)	790.5	649.5	5.10	1.00	8
PE(O-34:1)	704.6	563.5	5.35	1.00	11
PE(O-34:2)	702.5	561.5	5.14	1.00	12
PE(O-36:2)	730.5	589.5	5.48	1.00	9
PE(O-36:3)	728.6	587.5	5.19	1.00	11
PE(O-36:4)	726.5	585.5	5.17	1.00	10
PE(O-36:5)	724.5	583.5	4.97	1.00	12
PE(O-36:6)	722.5	581.5	4.94	1.00	11
PE(O-38:4)	754.6	613.6	5.51	1.00	9
PE(O-38:5)	752.6	611.5	5.22	1.00	12
PE(O-40:5)	780.6	639.6	5.53	1.00	13
PE(O-40:6)	778.5	637.5	5.15	1.00	14
PE(O-40:7)	776.6	635.5	5.20	1.00	11
PE(P-16:0/18:1)	702.5	561.5	5.34	7.31	15
PE(P-16:0/18:2)	700.5	559.5	5.13	7.31	9
PE(P-18:0/18:1)	730.5	589.5	5.66	7.31	9
PE(P-18:0/18:2)	728.6	587.5	5.46	7.31	8
PE(P-16:0/20:4)	724.5	583.5	5.14	7.31	10
PE(P-18:0/20:4)	752.6	611.5	5.48	7.31	13
PE(P-16:0/22:5)	750.5	609.6	5.17	7.31	9
PE(P-16:0/22:6)	748.5	607.5	5.10	7.31	13
PE(P-20:0/20:4)	780.6	639.6	5.75	7.31	8
PE(P-18:0/22:5)	778.5	637.5	5.49	7.31	9
PE(P-18:0/22:6)	776.6	635.5	5.44	7.31	13
LPE(16:0)	454.3	313.3	2.55	1.00	4
LPE(18:0)	482.3	341.3	2.90	1.00	4
LPE(18:1)	480.3	339.3	2.64	1.00	4
LPE(18:2)	478.3	337.3	2.44	1.00	3
LPE(20:4)	502.3	361.3	2.48	1.00	4
LPE(22:6)	526.3	385.3	2.49	1.00	5
PI(32:0)	828.6	551.6	4.10	1.44	8
PI(32:1)	826.5	549.5	3.87	1.44	7
PI(34:0)	856.6	579.6	4.68	1.44	31
PI(34:1)	854.6	577.6	4.21	1.44	8

Lipid [a]	Parent ion (m/z)	Product ion (m/z)	Retention time (min)	Correction factor[b]	% CV[c]
PI(36:1)	882.6	605.6	4.55	1.44	6
PI(36:2)	880.6	603.6	4.34	1.44	7
PI(36:3)	878.6	601.6	4.11	1.44	7
PI(36:4)	876.6	599.6	4.03	1.44	8
PI(38:2)	908.6	631.6	4.64	1.44	16
PI(38:3)	906.6	629.6	4.48	1.44	6
PI(38:4)	904.6	627.6	4.38	1.44	8
PI(38:5)	902.6	625.6	4.11	1.44	8
PI(38:6)	900.6	623.6	4.02	1.44	8
PI(40:4)	932.6	655.6	4.62	1.44	11
PI(40:5)	930.6	653.6	4.43	1.44	6
PI(40:6)	928.6	651.6	4.36	1.44	7
LPI(18:0)	618.3	341.3	2.40	1.00	16
LPI(18:1)	616.3	339.3	2.16	1.00	11
LPI(18:2)	614.3	337.3	1.96	1.00	8
LPI(20:4)	638.3	361.3	1.99	1.00	12
PG(34:1)	766.6	577.5	4.41	1.00	13
PG(36:1)	794.6	605.6	4.75	1.00	20
PG(36:2)	792.6	603.5	4.54	1.00	14
Cholesterol	404.4	369.4	5.13	1.00	11
CE(14:0)	614.6	369.3	7.88	2.04	12
CE(15:0)	628.6	369.3	7.96	1.56	8
CE(16:0)	642.6	369.3	8.04	1.27	6
CE(16:1)	640.6	369.3	7.88	0.69	13
CE(16:2)	638.6	369.3	7.75	0.21	11
CE(17:0)	656.6	369.3	8.10	1.08	9
CE(17:1)	654.6	369.3	7.96	0.58	9
CE(18:0)	670.7	369.3	8.17	0.93	8
CE(18:1)	668.6	369.3	8.02	0.50	11
CE(18:2)	666.6	369.3	7.90	0.15	12
CE(18:3)	664.6	369.3	7.78	0.15	13
CE(20:1)	696.7	369.3	8.20	0.39	13
CE(20:2)	694.7	369.3	8.03	0.12	16
CE(20:3)	692.6	369.3	7.93	0.12	12
CE(20:4)	690.6	369.3	7.81	0.12	10
CE(20:5)	688.6	369.3	7.70	0.12	13
CE(22:0)	726.7	369.3	8.39	0.60	11
CE(22:1)	724.7	369.3	8.31	0.32	15
CE(22:4)	718.7	369.3	7.94	0.10	11
CE(22:5)	716.6	369.3	7.85	0.10	12
CE(22:6)	714.6	369.3	7.75	0.10	13
CE(24:0)	754.7	369.3	8.51	0.51	9
CE(24:1)	752.7	369.3	8.37	0.27	17
CE(24:4)	746.7	369.3	8.11	0.08	13
CE(24:5)	744.7	369.3	7.96	0.08	20

Lipid [a]	Parent ion (m/z)	Product ion (m/z)	Retention time (min)	Correction factor[b]	% CV[c]
CE(24:6)	742.7	369.3	7.87	0.08	16
DG(14:0_16:0)	558.5	313.3	6.41	2.00	15
DG(14:0_18:1)	584.5	339.3	6.54	2.00	9
DG(14:0_18:2)	582.5	285.2	6.25	2.00	17
DG(16:0_16:0)	586.5	313.2	6.68	1.00	12
DG(16:0_18:0)	614.6	341.3	6.92	2.00	18
DG(16:0_18:1)	612.6	339.3	6.63	2.00	8
DG(16:0_18:2)	610.5	313.2	6.54	2.00	6
DG(16:0_20:0)	642.6	313.3	7.16	2.00	11
DG(16:0_20:3)	636.6	313.3	6.65	2.00	11
DG(16:0_20:4)	634.5	313.2	6.57	2.00	13
DG(16:0_22:5)	660.6	313.3	6.58	2.00	11
DG(16:0_22:6)	658.5	313.2	6.53	2.00	6
DG(16:1_18:0)	612.6	311.3	6.72	2.00	7
DG(16:1_18:1)	610.5	339.2	6.53	2.00	14
DG(18:0_18:0)	642.6	341.3	7.08	1.00	8
DG(18:0_18:1)	640.6	339.3	6.89	2.00	7
DG(18:0_18:2)	638.6	341.3	6.84	2.00	9
DG(18:0_20:4)	662.6	341.3	6.81	2.00	10
DG(18:1_18:1)	638.6	339.3	6.70	1.00	9
DG(18:1_18:2)	636.6	339.3	6.62	2.00	10
DG(18:1_18:3)	634.5	339.2	6.37	2.00	6
DG(18:1_20:0)	668.6	369.3	7.10	2.00	9
DG(18:1_20:3)	662.6	339.3	6.71	2.00	8
DG(18:1_20:4)	660.6	339.3	6.60	2.00	11
DG(18:2_18:2)	634.5	337.2	6.33	1.00	10
TG(14:0_16:0_18:1)	822.8	523.5	8.10	3.00	19
TG(14:0_16:0_18:2)	820.8	547.5	7.94	3.00	20
TG(14:0_16:1_18:1)	820.8	521.5	7.94	3.00	19
TG(14:0_16:1_18:2)	818.8	521.5	7.84	3.00	20
TG(14:0_17:0_18:1)	836.8	537.5	8.20	3.00	20
TG(14:0_18:0_18:1)	850.8	605.6	8.15	3.00	20
TG(14:0_18:2_18:2)	844.8	599.5	7.85	3.00	18
TG(14:1_16:0_18:1)	820.8	577.6	7.94	3.00	19
TG(14:1_16:1_18:0)	820.8	549.5	7.94	3.00	19
TG(14:1_18:0_18:2)	846.8	603.6	7.94	3.00	16
TG(14:1_18:1_18:1)	846.8	547.5	7.95	1.50	25
TG(15:0_16:0_18:1)	836.8	577.5	8.25	3.00	20
TG(15:0_18:1_18:1)	862.8	603.6	8.09	3.00	18
TG(16:0_16:0_16:0)	824.8	551.5	8.14	1.00	17
TG(16:0_16:0_18:0)	852.8	551.5	8.25	3.00	20
TG(16:0_16:0_18:1)	851.8	552.5	8.20	3.00	20
TG(16:0_16:0_18:2)	848.8	551.5	8.06	3.00	22
TG(16:0_16:1_17:0)	836.8	563.5	8.20	3.00	17
TG(16:0_16:1_18:1)	848.8	549.5	8.02	3.00	16

Lipid [a]	Parent ion (m/z)	Product ion (m/z)	Retention time (min)	Correction factor[b]	% CV[c]
TG(16:0_17:0_18:0)	866.8	593.6	8.35	3.00	19
TG(16:0_17:0_18:1)	864.8	565.5	8.30	3.00	19
TG(16:0_17:0_18:2)	862.8	589.6	8.20	3.00	19
TG(16:0_18:0_18:1)	878.8	577.5	8.24	3.00	18
TG(16:0_18:1_18:1)	876.8	603.6	8.12	3.00	21
TG(16:0_18:1_18:2)	874.8	577.6	8.05	3.00	19
TG(16:0_18:2_18:2)	872.8	599.6	7.96	3.00	20
TG(16:1_16:1_16:1)	818.8	547.5	7.82	1.00	21
TG(16:1_16:1_18:0)	848.8	547.5	8.06	3.00	23
TG(16:1_16:1_18:1)	846.8	575.6	7.93	1.50	26
TG(16:1_17:0_18:1)	862.8	563.5	8.20	3.00	20
TG(16:1_18:1_18:1)	874.8	603.6	8.06	3.00	20
TG(16:1_18:1_18:2)	872.8	573.6	7.96	3.00	19
TG(17:0_18:1_18:1)	890.8	603.6	8.19	3.00	23
TG(18:0_18:0_18:0)	908.9	607.6	8.42	1.00	15
TG(18:0_18:0_18:1)	906.9	607.6	8.35	3.00	17
TG(18:0_18:1_18:1)	904.9	603.6	8.26	3.00	23
TG(18:0_18:2_18:2)	900.8	599.5	8.08	3.00	23
TG(18:1_18:1_18:1)	902.8	902.8	8.15	1.00	22
TG(18:1_18:1_18:2)	900.9	603.9	8.04	3.00	24
TG(18:1_18:1_20:4)	924.9	603.6	8.02	3.00	22
TG(18:1_18:1_22:6)	948.9	603.7	7.97	3.00	22
TG(18:1_18:2_18:2)	898.9	599.6	7.99	3.00	22
TG(18:2_18:2_18:2)	896.9	599.6	7.89	1.00	19
TG(18:2_18:2_20:4)	920.9	599.6	7.83	3.00	17

[a] CE, cholesteryl ester; Cer(d18:0), dihydroceramide; Cer(d18:1), ceramide; COH, free cholesterol; DG, diacylglycerol; HexCer, monohexosylceramide; Hex2Cer, dihexosylceramide; Hex3Cer, trihexosylceramide; GM3, G_{M3} ganglioside; LPC, lysophosphatidylcholine; LPC(O), lysoalkylphosphatidylcholine; LPE, lysophosphatidylethanolamine; LPI, lysophosphatidylinositol; PC, phosphatidylcholine; PC(O), alkylphosphatidylcholine; PC(P), alkenylphosphatidylcholine; PE, phosphatidylethanolamine; PE(O), alkylphosphatidylethanolamine; PE(P), alkenylphosphatidylethanolamine; PG, phosphatidylglycerol; PI, phosphatidylinositol; SM, sphingomyelin; TG, triacylglycerol.

[b] values by which the analyte concentration is multiplied by adjust for differential responses.

[c] %CV based on variance between 10 quality control samples spread across the entire analytical run

Supplementary Table 3: Demographic and clinical characteristics of study participants

Variable [a]	Healthy (N=40) [b]	Metabolic syndrome (N=94) [b]	P-value [c]
Age (years)	54±4	56±6	NS
Sex (Males/Females)	(19/21)	(56/38)	NS
SBP (mmHg)	121±9	136±16	<0.001
BMI (kg/m2)	23±2	33±4	<0.001
Fasting glucose (mmol/L)	5.0±0.5	5.9±0.7	<0.001
Triacylglycerol (mmol/L)	0.75±0.28	1.83±1.06	<0.001
Total cholesterol (mmol/L)	4.76±0.42	5.55±0.91	<0.01
LDL-C (mmol/L)	2.71±0.52	3.51±0.78	<0.001
HDL-C (mmol/L)	1.71±0.28	1.21±0.26	<0.001
Apolipoprtein A-I (g/L)	1.69±0.22	1.43±0.24	<0.001

[a] SBP: systolic blood pressure; BMI: body mass index; LDL-C: low-density lipoprotein-cholesterol; HDL: high-density lipoprotein-cholesterol.

[b] Values are Means ± standard deviations.

[c] P-values calculated using student t-test, NS: not significant.

Supplementary Table 4: Plasma lipid classes/subclasses in metabolic syndrome and healthy individuals

Lipid [a]	Healthy [b]	MetS VS Healthy	
		% difference [c]	P-value [d]
Dihydroceramide	3.13 ± 0.94	12	NS
Ceramide	5.30 ± 1.30	8	NS
Monohexosylceramide	8.69 ± 2.43	-9	NS
Dihexosylceramide	22.5 ± 5.40	-22	**<0.001**
Trihexosylceramide	2.97 ± 0.51	-24	**<0.001**
GM3 ganglioside	4.04 ± 0.69	-12	**<0.01**
Sphingomyelin	304 ± 44	-5	**<0.05**
Phosphatidylcholine	849 ± 90	-2	NS
Alkylphosphatidylcholine	30.7 ± 4.8	-18	**<0.001**
Alkenylphosphatidylcholine	17.1 ± 3.3	-20	**<0.001**
Lysophosphatidylcholine	102 ± 21	-24	**<0.001**
Lysoalkylphosphatidylcholine	0.85 ± 0.16	-35	**<0.001**
Phosphatidylethanolamine	40.0 ± 23.7	-7	NS
Alkylphosphatidylethanolamine	4.41 ± 1.58	-17	**<0.05**
Alkenylphosphatidylethanolamine	43.3 ± 22.1	-20	**<0.05**
Lysophosphatidylethanolamine	8.58 ± 2.70	-23	**<0.01**
Phosphatidylinositol	43.8 ± 10.2	7	NS
Lysophosphatidylinositol	0.31 ± 0.08	-6	NS
Phosphatidylglycerol	0.19 ± 0.09	36	**<0.01**
Free cholesterol	1247 ± 185	-6	**<0.05**
Cholesterol ester	3586 ± 889	43	**<0.01**
Diacylglycerol	66.2 ± 19.3	45	**<0.001**
Triacylglycerol	266 ± 90	58	**<0.001**

[a] Represents the sum of the individual lipid species within that group.
[b] Values are mean ± standard deviation for healthy individuals (µmol/L).
[c] % difference of the Means between the MetS and the healthy individuals, healthy individuals as a reference.
[d] Data were log transformed, and significance in P-values determined by student t-test (MetS vs healthy), corrected for multiple comparisons by the method of Benjamini Hochberg, NS: not significant.

Supplementary Table 5: Plasma lipid species in metabolic syndrome and healthy individuals

Lipid species [a]	Healthy [b]	MetS vs Healthy	
		% difference [c]	P-value [d]
Cer(d18:0/16:0)	0.1 ± 0.02	5	2.60E-01
Cer(d18:0/18:0)	0.04 ± 0.03	32	**5.60E-04**
Cer(d18:0/20:0)	0.05 ± 0.04	18	**5.30E-03**
Cer(d18:0/22:0)	0.2 ± 0.09	25	**1.50E-03**
Cer(d18:0/24:0)	0.21 ± 0.13	30	**2.00E-03**
Cer(d18:0/24:1)	2.53 ± 0.81	9	2.10E-01
Cer(d18:1/16:0)	0.33 ± 0.09	-1	9.90E-01
Cer(d18:1/18:0)	0.11 ± 0.05	28	**1.80E-04**
Cer(d18:1/20:0)	0.11 ± 0.06	3	3.30E-01
Cer(d18:1/22:0)	0.84 ± 0.24	11	9.00E-02
Cer(d18:1/24:0)	3.21 ± 0.98	6	2.40E-01
Cer(d18:1/24:1)	0.71 ± 0.18	8	1.80E-01
HexCer(d18:1/16:0)	0.92 ± 0.25	-2	6.70E-01
HexCer(d18:1/18:0)	0.12 ± 0.04	76	2.80E-01
HexCer(d18:1/20:0)	0.14 ± 0.05	-8	2.40E-01
HexCer(d18:1/22:0)	2.06 ± 0.66	-8	2.50E-01
HexCer(d18:1/24:0)	3.02 ± 0.88	-7	2.70E-01
HexCer(d18:1/24:1)	2.41 ± 0.89	-17	**1.90E-02**
Hex2Cer(d18:1/16:0)	13.04 ± 2.32	-16	**6.40E-06**
Hex2Cer(d18:1/18:0)	0.12 ± 0.04	-30	**1.80E-05**
Hex2Cer(d18:1/20:0)	0.46 ± 0.32	-26	**2.10E-02**
Hex2Cer(d18:1/22:0)	1.83 ± 1.33	-35	**3.40E-05**
Hex2Cer(d18:1/24:0)	1.85 ± 1.49	-35	**8.40E-05**
Hex2Cer(d18:1/24:1)	5.22 ± 1.32	-27	**2.30E-08**
Hex3Cer(d18:1/16:0)	1.7 ± 0.29	-21	**6.60E-09**
Hex3Cer(d18:1/18:0)	0.23 ± 0.08	-20	**6.90E-04**
Hex3Cer(d18:1/20:0)	0.09 ± 0.04	-22	**6.00E-03**
Hex3Cer(d18:1/22:0)	0.33 ± 0.1	-32	**5.50E-07**
Hex3Cer(d18:1/24:0)	0.2 ± 0.07	-33	**9.50E-08**
Hex3Cer(d18:1/24:1)	0.43 ± 0.11	-28	**2.60E-07**
GM3(d18:1/16:0)	1.14 ± 0.18	-15	**4.80E-06**
GM3(d18:1/18:0)	0.43 ± 0.09	-14	**3.60E-04**
GM3(d18:1/20:0)	0.44 ± 0.07	-2	6.00E-01
GM3(d18:1/22:0)	0.73 ± 0.23	-9	1.10E-01
GM3(d18:1/24:0)	0.63 ± 0.19	-13	**1.70E-02**
GM3(d18:1/24:1)	0.67 ± 0.19	-17	**9.50E-04**
SM(31:1)	0.49 ± 0.18	-9	2.00E-01
SM(32:0)	0.36 ± 0.1	2	6.70E-01
SM(32:1)	14.02 ± 3.56	-1	9.10E-01
SM(32:2)	0.91 ± 0.26	9	2.60E-01
SM(33:1)	9.91 ± 2.69	-12	**2.30E-02**
SM(34:0)	2.97 ± 0.52	-5	6.20E-02
SM(34:1)	135.6 ± 22.73	-9	**2.00E-03**

Lipid species [a]	Healthy [b]	MetS vs Healthy	
		% difference [c]	P-value [d]
SM(34:2)	19.94 ± 2.89	-3	2.80E-01
SM(34:3)	0.12 ± 0.03	-2	5.40E-01
SM(35:1)	2.71 ± 0.74	-8	9.80E-02
SM(35:2)	0.51 ± 0.12	-7	1.00E-01
SM(36:1)	20.44 ± 6	10	1.50E-01
SM(36:2)	6.98 ± 1.42	5	4.20E-01
SM(36:3)	0.7 ± 0.15	-2	3.30E-01
SM(37:2)	0.55 ± 0.12	-10	**1.50E-02**
SM(38:1)	32.12 ± 5.19	1	9.70E-01
SM(38:2)	27.42 ± 3.6	-7	**1.30E-02**
SM(39:1)	5 ± 1.63	-8	1.90E-01
SM(41:1)	8.95 ± 2.52	2	8.40E-01
SM(41:2)	7.57 ± 1.7	-14	**7.60E-04**
SM(42:1)	6.71 ± 2.07	-2	6.20E-01
PC(28:0)	0.22 ± 0.13	3	8.30E-01
PC(29:0)	0.14 ± 0.04	-26	**8.50E-06**
PC(30:0)	1.43 ± 0.59	-5	5.20E-01
PC(31:0)	0.5 ± 0.2	-12	1.50E-01
PC(31:1)	0.98 ± 0.24	-8	8.50E-02
PC(32:0)	6.01 ± 1.69	-18	**3.30E-04**
PC(32:1)	11.24 ± 3.15	23	**3.10E-03**
PC(32:2)	3.9 ± 0.86	8	1.30E-01
PC(32:3)	0.3 ± 0.06	-3	3.10E-01
PC(33:0)	0.75 ± 0.21	-17	**2.70E-03**
PC(33:1)	2.14 ± 0.61	-2	6.80E-01
PC(33:2)	1.72 ± 0.51	-11	6.20E-02
PC(33:3)	0.09 ± 0.03	-11	**4.60E-02**
PC(34:0)	2.04 ± 0.7	-18	**3.80E-04**
PC(34:1)	123.76 ± 19.64	-1	6.40E-01
PC(34:2)	196.47 ± 30.25	-7	**4.10E-02**
PC(34:3)	9.11 ± 2.24	-5	2.50E-01
PC(34:4)	0.65 ± 0.24	7	3.90E-01
PC(34:5)	0.08 ± 0.07	4	3.70E-01
PC(35:0)	0.08 ± 0.02	-24	**1.80E-05**
PC(35:1)	3.68 ± 0.9	-11	**2.20E-02**
PC(35:2)	7.98 ± 2.05	-19	**3.30E-05**
PC(35:3)	0.96 ± 0.23	-9	**5.00E-02**
PC(35:4)	0.65 ± 0.19	-4	6.50E-01
PC(36:0)	0.09 ± 0.06	-27	**2.20E-04**
PC(36:1)	18.6 ± 4.53	-1	7.50E-01
PC(36:2)	128.9 ± 20.26	-7	**2.20E-02**
PC(36:3)	88.91 ± 14.97	-1	6.00E-01
PC(36:4)	76.47 ± 17.22	-1	9.10E-01
PC(36:5)	14.81 ± 4.43	-6	9.60E-01

Lipid species [a]	Healthy [b]	MetS vs Healthy	
		% difference [c]	P-value [d]
PC(36:6)	0.39 ± 0.2	2	6.30E-01
PC(37:4)	3.7 ± 0.79	-11	**8.60E-03**
PC(37:5)	0.86 ± 0.47	-17	1.50E-01
PC(37:6)	0.26 ± 0.14	-15	2.20E-01
PC(38:2)	5.87 ± 0.98	-11	**8.50E-04**
PC(38:3)	13.64 ± 3.02	29	**1.60E-05**
PC(38:4)	42.14 ± 12.37	8	1.20E-01
PC(38:5)	33.99 ± 8.79	-3	5.70E-01
PC(38:6)	35.04 ± 11.03	-6	4.70E-01
PC(38:7)	2.86 ± 1.08	-2	9.10E-01
PC(39:5)	0.58 ± 0.18	-16	**4.90E-03**
PC(39:6)	0.88 ± 0.39	-23	**6.40E-03**
PC(39:7)	0.07 ± 0.03	-26	**8.00E-04**
PC(40:4)	1.43 ± 0.41	9	2.90E-01
PC(40:5)	4.72 ± 1.3	10	1.10E-01
PC(40:6)	12.19 ± 4.8	9	1.70E-01
PC(40:7)	2.13 ± 0.7	-15	**1.20E-02**
PC(40:8)	0.5 ± 0.14	-29	**2.50E-08**
PC(O-32:0)	1.18 ± 0.2	-19	**1.20E-07**
PC(O-32:1)	0.24 ± 0.06	-26	**1.20E-07**
PC(O-32:2)	0.04 ± 0.02	-40	**3.00E-05**
PC(O-34:1)	1.94 ± 0.4	-30	**8.30E-12**
PC(O-34:2)	2.12 ± 0.59	-29	**1.90E-08**
PC(O-34:3)	0.08 ± 0.03	-12	**4.10E-02**
PC(O-34:4)	0.12 ± 0.04	-31	**2.00E-07**
PC(O-35:4)	0.84 ± 0.19	-5	2.10E-01
PC(O-36:0)	0.03 ± 0.04	-48	**2.10E-05**
PC(O-36:1)	0.22 ± 0.06	-32	**2.80E-09**
PC(O-36:2)	1.23 ± 0.41	-36	**1.80E-10**
PC(O-36:3)	3.39 ± 0.79	-18	**3.10E-05**
PC(O-36:4)	7.07 ± 1.32	-11	**3.00E-03**
PC(O-36:5)	0.73 ± 0.45	-17	1.90E-01
PC(O-38:4)	1.74 ± 0.46	-16	**1.20E-03**
PC(O-38:5)	7.21 ± 1.53	-17	**3.40E-05**
PC(O-40:5)	0.77 ± 0.16	-25	**5.10E-09**
PC(O-40:6)	0.67 ± 0.18	-25	**1.40E-06**
PC(O-40:7)	1.07 ± 0.41	-23	**4.00E-04**
PC(P-30:0)	0.06 ± 0.02	-20	**2.30E-04**
PC(P-32:0)	0.87 ± 0.19	-18	**1.70E-05**
PC(P-32:1)	0.11 ± 0.02	-18	**5.70E-06**
PC(P-34:1)	1.36 ± 0.3	-32	**1.70E-12**
PC(P-34:2)	2.67 ± 0.64	-33	**6.10E-12**
PC(P-34:3)	0.34 ± 0.08	-32	**1.10E-11**
PC(P-36:2)	0.76 ± 0.22	-38	**1.30E-11**

Lipid species [a]	Healthy [b]	MetS vs Healthy	
		% difference [c]	P-value [d]
PC(P-36:4)	4.78 ± 1.01	-10	**1.60E-02**
PC(P-36:5)	0.5 ± 0.35	-18	2.70E-01
PC(P-38:4)	0.95 ± 0.27	-15	**4.80E-03**
PC(P-38:5)	2.23 ± 0.67	-16	**5.50E-03**
PC(P-38:6)	1.34 ± 0.55	-20	**1.30E-02**
PC(P-40:5)	0.76 ± 0.3	-25	**4.10E-05**
PC(P-40:6)	0.38 ± 0.12	-26	**1.60E-05**
LPC(14:0)	1.16 ± 0.33	-6	3.10E-01
LPC(15:0)	0.65 ± 0.17	-20	**4.10E-05**
LPC(16:0)	43.16 ± 9.13	-21	**5.20E-07**
LPC(16:1)	1.94 ± 0.48	-8	6.10E-02
LPC(17:0)	1.12 ± 0.27	-31	**3.00E-10**
LPC(17:1)	0.21 ± 0.05	-27	**1.80E-08**
LPC(18:0)	13.73 ± 2.92	-20	**2.50E-06**
LPC(18:1)	11.98 ± 3.13	-31	**1.80E-09**
LPC(18:2)	19.25 ± 6.16	-37	**4.00E-09**
LPC(18:3)	0.49 ± 0.2	-33	**1.60E-06**
LPC(20:0)	0.1 ± 0.03	-37	**1.80E-09**
LPC(20:1)	0.17 ± 0.05	-44	**3.60E-13**
LPC(20:2)	0.17 ± 0.05	-26	**8.20E-07**
LPC(20:3)	1.49 ± 0.46	-6	2.90E-01
LPC(20:4)	3.69 ± 1.27	-20	**1.90E-03**
LPC(20:5)	0.98 ± 0.63	-24	7.80E-02
LPC(22:0)	0.03 ± 0.01	-30	**3.80E-06**
LPC(22:1)	0.02 ± 0.01	-45	**1.20E-09**
LPC(22:5)	0.36 ± 0.11	-21	**3.90E-04**
LPC(22:6)	1.24 ± 0.5	-23	**2.30E-03**
LPC(24:0)	0.05 ± 0.02	-25	**3.90E-05**
LPC(26:0)	0.01 ± 0	-31	**7.80E-09**
LPC(O-16:0)	0.3 ± 0.07	-34	**3.30E-13**
LPC(O-18:0)	0.1 ± 0.03	-41	**5.70E-12**
LPC(O-18:1)	0.19 ± 0.06	-42	**1.60E-12**
LPC(O-20:0)	2.22 ± 0.06	0	7.80E-01
LPC(O-20:1)	0.02 ± 0	-34	**3.00E-13**
LPC(O-22:0)	0.07 ± 0.01	-27	**2.90E-11**
LPC(O-22:1)	0.03 ± 0.01	-45	**3.10E-19**
LPC(O-24:0)	0.06 ± 0.01	-18	**6.10E-06**
LPC(O-24:1)	0.07 ± 0.01	-30	**1.00E-11**
LPC(O-24:2)	0.02 ± 0.01	-43	**4.10E-13**
PE(32:0)	0.07 ± 0.04	-41	**2.30E-05**
PE(32:1)	0.13 ± 0.08	30	7.40E-02
PE(34:1)	1.55 ± 1.22	-14	5.00E-01
PE(34:2)	2.54 ± 1.39	-5	7.30E-01
PE(34:3)	0.19 ± 0.11	-12	3.70E-01

Lipid species [a]	Healthy [b]	MetS vs Healthy	
		% difference [c]	P-value [d]
PE(35:1)	0.11 ± 0.06	-16	1.10E-01
PE(35:2)	0.18 ± 0.1	-15	1.90E-01
PE(36:0)	0.026 ± 0.01	-6	3.60E-01
PE(36:1)	1.16 ± 0.91	-9	8.40E-01
PE(36:2)	5.63 ± 3.38	3	6.70E-01
PE(36:3)	2.57 ± 1.71	-26	**4.40E-02**
PE(36:4)	3.2 ± 2.02	-14	3.60E-01
PE(36:5)	0.26 ± 0.16	-13	2.60E-01
PE(38:3)	0.76 ± 0.58	22	**4.10E-02**
PE(38:4)	8.7 ± 8.04	-15	6.50E-01
PE(38:5)	4.17 ± 2.62	-20	7.40E-02
PE(38:6)	5.1 ± 2.57	-3	9.10E-01
PE(40:4)	0.3 ± 0.49	-36	1.10E-01
PE(40:5)	0.13 ± 0.09	34	**3.90E-02**
PE(40:6)	2.57 ± 1.39	28	**1.00E-02**
PE(40:7)	0.71 ± 0.38	-19	9.50E-02
PE(O-34:1)	0.19 ± 0.07	-21	**6.20E-04**
PE(O-34:2)	0.16 ± 0.06	-25	**1.40E-04**
PE(O-36:2)	0.16 ± 0.13	-36	**1.60E-04**
PE(O-36:3)	0.18 ± 0.08	-15	**2.20E-02**
PE(O-36:4)	0.79 ± 0.28	-9	8.20E-02
PE(O-36:5)	0.14 ± 0.08	-16	9.80E-02
PE(O-36:6)	0.1 ± 0.09	-15	9.10E-01
PE(O-38:4)	0.8 ± 0.31	-14	**3.10E-02**
PE(O-38:5)	0.84 ± 0.34	-13	8.50E-02
PE(O-40:5)	0.24 ± 0.09	-21	**1.00E-03**
PE(O-40:6)	0.42 ± 0.16	-15	**4.30E-02**
PE(O-40:7)	0.39 ± 0.33	-33	**2.80E-03**
PE(P-34:1)	0.72 ± 0.35	-26	**2.00E-04**
PE(P-34:2)	1.72 ± 0.73	-15	6.80E-02
PE(P-36:1)	0.56 ± 0.25	-21	**7.10E-03**
PE(P-36:2)	2.43 ± 1.04	-22	**1.90E-03**
PE(P-36:4)	6.15 ± 5.52	-19	1.30E-01
PE(P-38:4)	7.38 ± 5.89	-23	**2.40E-02**
PE(P-38:5)	11.29 ± 4.61	-15	**4.50E-02**
PE(P-38:6)	5.4 ± 2.5	-11	2.90E-01
PE(P-40:4)	1.46 ± 2.1	-50	**5.80E-06**
PE(P-40:5)	3.56 ± 1.66	-28	**2.50E-05**
PE(P-40:6)	2.59 ± 1.17	-20	**6.00E-03**
LPE(16:0)	1.41 ± 0.41	-25	**5.00E-06**
LPE(18:0)	1.87 ± 0.77	-28	**1.50E-05**
LPE(18:1)	1.26 ± 0.58	-29	**7.90E-04**
LPE(18:2)	2.05 ± 1.03	-27	**6.00E-03**
LPE(20:4)	1.12 ± 0.44	-14	5.30E-02

Lipid species [a]	Healthy [b]	MetS vs Healthy	
		% difference [c]	P-value [d]
LPE(22:6)	0.87 ± 0.3	-11	1.40E-01
PI(32:0)	0.17 ± 0.11	15	4.40E-01
PI(32:1)	0.31 ± 0.17	96	**3.00E-06**
PI(34:0)	0.04 ± 0.01	4	3.70E-01
PI(34:1)	2.22 ± 0.68	30	**1.80E-03**
PI(36:1)	2 ± 0.54	4	8.50E-01
PI(36:2)	5.82 ± 1.38	0	7.20E-01
PI(36:3)	1.51 ± 0.46	-2	6.40E-01
PI(36:4)	2.05 ± 0.64	21	**2.50E-02**
PI(38:2)	0.29 ± 0.1	-5	2.90E-01
PI(38:3)	3.55 ± 1.16	17	**3.50E-02**
PI(38:4)	20.94 ± 6.53	4	4.60E-01
PI(38:5)	1.79 ± 0.64	-12	5.50E-02
PI(38:6)	0.47 ± 0.18	-2	6.40E-01
PI(40:4)	0.28 ± 0.1	7	4.50E-01
PI(40:5)	1.17 ± 0.35	15	**3.50E-02**
PI(40:6)	1.22 ± 0.51	3	5.30E-01
LPI(18:0)	0.05 ± 0.02	-4	6.00E-01
LPI(18:1)	0.05 ± 0.02	-9	1.40E-01
LPI(18:2)	0.07 ± 0.03	-11	1.90E-01
LPI(20:4)	0.14 ± 0.04	-4	5.10E-01
PG(34:1)	0.07 ± 0.04	12	2.00E-01
PG(36:1)	0.06 ± 0.03	66	**1.00E-05**
PG(36:2)	0.06 ± 0.03	33	**2.40E-03**
Cholesterol	1246.63 ± 185.2	-6	**4.40E-02**
CE(14:0)	27.34 ± 11.64	57	**1.60E-05**
CE(15:0)	13.49 ± 5.85	7	3.40E-01
CE(16:0)	234.01 ± 37.52	15	**3.60E-04**
CE(16:1)	115.48 ± 54.28	102	**8.50E-08**
CE(16:2)	2.93 ± 1.29	76	**2.00E-07**
CE(17:0)	13.57 ± 5.2	4	6.30E-01
CE(17:1)	16.22 ± 8.25	14	1.20E-01
CE(18:0)	25.81 ± 6.15	21	**1.00E-03**
CE(18:1)	682.72 ± 182.58	18	**6.90E-03**
CE(18:2)	1388.9 ± 363.59	39	**1.00E-05**
CE(18:3)	139.43 ± 51.37	72	**7.20E-07**
CE(20:1)	1.15 ± 0.28	25	**4.30E-04**
CE(20:2)	0.73 ± 0.23	18	**1.40E-02**
CE(20:3)	34.36 ± 11.16	74	**1.60E-09**
CE(20:4)	485.14 ± 175.44	62	**2.60E-07**
CE(20:5)	261.52 ± 156.07	64	**3.40E-05**
CE(22:0)	1.05 ± 0.27	65	**4.00E-09**
CE(22:1)	0.734 ± 0.24	46	**4.10E-07**
CE(22:4)	0.71 ± 0.25	32	**8.00E-04**

Lipid species [a]	Healthy [b]	MetS vs Healthy	
		% difference [c]	P-value [d]
CE(22:5)	7.39 ± 2.5	56	**8.60E-06**
CE(22:6)	133.42 ± 51.89	63	**9.60E-06**
CE(24:0)	0.55 ± 0.15	69	**4.00E-09**
CE(24:1)	0.35 ± 0.09	54	**2.40E-07**
CE(24:4)	0.11 ± 0.03	36	**1.90E-06**
CE(24:5)	0.10 ± 0.02	47	**2.20E-04**
CE(24:6)	0.18 ± 0.07	64	**2.90E-07**
DG(14:0_16:0)	0.28 ± 0.09	46	**7.30E-06**
DG(14:0_18:1)	0.9 ± 0.32	65	**4.30E-08**
DG(14:0_18:2)	0.28 ± 0.16	59	**5.50E-05**
DG(16:0_16:0)	2.39 ± 0.41	28	**3.50E-06**
DG(16:0_18:0)	10.56 ± 1.21	2	6.70E-01
DG(16:0_18:1)	7.49 ± 2.86	87	**3.00E-10**
DG(16:0_18:2)	3.13 ± 1.33	49	**7.60E-06**
DG(16:0_20:0)	0.1 ± 0.04	2	8.20E-01
DG(16:0_20:3)	0.22 ± 0.13	56	**1.90E-04**
DG(16:0_20:4)	0.76 ± 0.3	20	**1.40E-02**
DG(16:0_22:5)	0.2 ± 0.11	59	**8.40E-06**
DG(16:0_22:6)	0.74 ± 0.37	29	**6.20E-04**
DG(16:1_18:0)	0.46 ± 0.08	28	**3.10E-06**
DG(16:1_18:1)	2.22 ± 1.06	107	**3.00E-10**
DG(18:0_18:0)	7.14 ± 0.95	-1	6.40E-01
DG(18:0_18:1)	1.6 ± 0.63	79	**2.40E-08**
DG(18:0_18:2)	1.26 ± 0.41	30	**2.60E-04**
DG(18:0_20:4)	0.39 ± 0.53	-26	2.70E-01
DG(18:1_18:1)	10.47 ± 4.54	88	**1.80E-09**
DG(18:1_18:2)	8.61 ± 4.1	49	**4.20E-05**
DG(18:1_18:3)	1.5 ± 0.81	37	**4.70E-04**
DG(18:1_20:0)	0.7 ± 0.16	0	6.70E-01
DG(18:1_20:3)	1.16 ± 0.56	26	**6.80E-03**
DG(18:1_20:4)	1.99 ± 1.06	29	**7.00E-03**
DG(18:2_18:2)	1.63 ± 0.86	21	**3.60E-02**
TG(14:0_16:0_18:1)	2.56 ± 2.02	114	**2.40E-06**
TG(14:0_16:0_18:2)	4.83 ± 3.45	101	**5.70E-06**
TG(14:0_16:1_18:1)	4.81 ± 3.45	98	**3.10E-06**
TG(14:0_16:1_18:2)	2.08 ± 2.02	58	**3.90E-04**
TG(14:0_17:0_18:1)	1.96 ± 1.2	70	**3.40E-05**
TG(14:0_18:0_18:1)	0.22 ± 0.21	50	**1.10E-03**
TG(14:0_18:2_18:2)	1.46 ± 0.96	41	**7.50E-03**
TG(14:1_16:0_18:1)	0.93 ± 0.64	102	**6.60E-06**
TG(14:1_16:1_18:0)	3.61 ± 2.29	136	**1.20E-07**
TG(14:1_18:0_18:2)	0.21 ± 0.09	56	**1.00E-05**
TG(14:1_18:1_18:1)	3.49 ± 1.71	64	**4.70E-06**
TG(15:0_16:0_18:1)	0.37 ± 0.23	90	**1.60E-05**

Lipid species [a]	Healthy [b]	MetS vs Healthy	
		% difference [c]	P-value [d]
TG(15:0_18:1_18:1)	0.51 ± 0.24	57	**1.00E-05**
TG(16:0_16:0_16:0)	0.79 ± 0.69	79	**5.80E-04**
TG(16:0_16:0_18:0)	1.17 ± 0.89	78	**4.70E-04**
TG(16:0_16:0_18:1)	7.87 ± 3.84	88	**2.60E-07**
TG(16:0_16:0_18:2)	6.96 ± 4.51	50	**5.60E-04**
TG(16:0_16:1_17:0)	1.87 ± 1.21	93	**8.80E-06**
TG(16:0_16:1_18:1)	25.79 ± 11.14	97	**3.80E-09**
TG(16:0_17:0_18:0)	0.08 ± 0.06	86	**2.90E-04**
TG(16:0_17:0_18:1)	0.69 ± 0.39	93	**3.00E-06**
TG(16:0_17:0_18:2)	2.41 ± 1.13	77	**2.00E-07**
TG(16:0_18:0_18:1)	3.49 ± 2.25	100	**2.70E-06**
TG(16:0_18:1_18:1)	64.14 ± 18.46	56	**2.00E-08**
TG(16:0_18:1_18:2)	43.09 ± 18.89	43	**6.50E-05**
TG(16:0_18:2_18:2)	6.68 ± 3.46	40	**2.40E-03**
TG(16:1_16:1_16:1)	0.21 ± 0.13	111	**7.30E-07**
TG(16:1_16:1_18:0)	0.41 ± 0.36	39	**2.70E-03**
TG(16:1_16:1_18:1)	4.09 ± 1.96	94	**6.40E-08**
TG(16:1_17:0_18:1)	5.9 ± 2.65	61	**2.60E-07**
TG(16:1_18:1_18:1)	2.98 ± 1.37	62	**2.50E-06**
TG(16:1_18:1_18:2)	10.57 ± 4.37	49	**1.80E-05**
TG(17:0_18:1_18:1)	0.77 ± 0.35	62	**1.20E-05**
TG(18:0_18:0_18:0)	0.36 ± 0.11	-2	6.40E-01
TG(18:0_18:0_18:1)	1.01 ± 0.74	116	**2.10E-05**
TG(18:0_18:1_18:1)	3.01 ± 1.51	92	**3.50E-07**
TG(18:0_18:2_18:2)	1.61 ± 0.83	6	4.30E-01
TG(18:1_18:1_18:1)	25.3 ± 8.72	18	5.20E-02
TG(18:1_18:1_18:2)	3.19 ± 1.87	11	2.00E-01
TG(18:1_18:1_20:4)	1.78 ± 0.93	14	1.10E-01
TG(18:1_18:1_22:6)	0.78 ± 0.63	23	8.30E-02
TG(18:1_18:2_18:2)	10.95 ± 6.8	8	3.00E-01
TG(18:2_18:2_18:2)	0.71 ± 0.58	-3	7.80E-01
TG(18:2_18:2_20:4)	0.35 ± 0.23	-9	7.50E-01

[a] CE, cholesteryl ester; Cer(d18:0), dihydroceramide; Cer(d18:1), ceramide; COH, free cholesterol; DG, diacylglycerol; HexCer, monohexosylceramide; Hex2Cer, dihexosylceramide; Hex3Cer, trihexosylceramide; GM3, G_{M3} ganglioside; LPC, lysophosphatidylcholine; LPC(O), lysoalkylphosphatidylcholine; LPE, lysophosphatidylethanolamine; LPI, lysophosphatidylinositol; PC, phosphatidylcholine; PC(O), alkylphosphatidylcholine; PC(P), alkenylphosphatidylcholine; PE, phosphatidylethanolamine; PE(O), alkylphosphatidylethanolamine; PE(P), alkenylphosphatidylethanolamine; PG, phosphatidylglycerol; PI, phosphatidylinositol; SM, sphingomyelin; TG, triacylglycerol.

[b] Values are mean ± standard deviation for healthy individuals (µmol/L).

[c] % difference of the Means between the MetS and the healthy individuals, healthy individuals as a reference.

[d] Data were log transformed, and significance in P-values determined by student t-test (MetS vs healthy), corrected for multiple comparisons by the method of Benjamini Hochberg.

Table 6: Linear regression analysis of plasma lipid species against log-norepinephrine, non-esterified fatty acids and heart rate in MetS

Lipid species [a]	Log-Norepinephrine			Non-esterified fatty acids			Heart Rate		
	β-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]
Cer(d18:0/16:0)	0.013 (-0.028-0.055)	5.25E-01	7.30E-01	0.004 (-0.028-0.037)	8.01E-01	9.20E-01	1.5 (-0.32-3.33)	1.11E-01	2.64E-01
Cer(d18:0/18:0)	0.041 (-0.018-0.099)	1.76E-01	4.02E-01	0.071 (0.029-0.113)	**1.48E-03**	**2.79E-02**	3.03 (0.6-5.45)	**1.64E-02**	1.27E-01
Cer(d18:0/20:0)	0.038 (-0.016-0.092)	1.68E-01	3.94E-01	0.03 (-0.011-0.072)	1.56E-01	3.89E-01	3.19 (0.88-5.49)	**8.16E-03**	9.61E-02
Cer(d18:0/22:0)	0.051 (0.001-0.101)	**4.89E-02**	1.84E-01	0.031 (-0.007-0.068)	1.16E-01	3.23E-01	3.1 (1.01-5.19)	**4.56E-03**	7.37E-02
Cer(d18:0/24:0)	0.037 (-0.010-0.085)	1.28E-01	3.31E-01	0.033 (-0.004-0.069)	8.01E-02	2.66E-01	2.35 (0.3-4.4)	**2.75E-02**	1.49E-01
Cer(d18:0/24:1)	0.070 (0.021-0.120)	**6.95E-03**	6.93E-02	0.017 (-0.023-0.057)	4.20E-01	6.93E-01	2.1 (-0.15-4.34)	7.09E-02	2.16E-01
Cer(d18:1/16:0)	0.049 (-0.004-0.103)	7.58E-02	2.47E-01	0.051 (0.01-0.092)	**1.63E-02**	9.89E-02	3.49 (1.2-5.78)	**3.70E-03**	6.97E-02
Cer(d18:1/18:0)	0.013 (-0.043-0.068)	6.60E-01	8.32E-01	0.055 (0.015-0.096)	**8.78E-03**	7.09E-02	3.16 (0.88-5.44)	**7.91E-03**	9.61E-02
Cer(d18:1/20:0)	0.049 (0.002-0.096)	**4.48E-02**	1.77E-01	0.027 (-0.011-0.064)	1.68E-01	4.04E-01	3.09 (1.03-5.15)	**4.24E-03**	7.37E-02
Cer(d18:1/22:0)	0.065 (0.017-0.114)	**9.76E-03**	7.69E-02	0.02 (-0.018-0.058)	3.09E-01	5.82E-01	2.73 (0.68-4.79)	**1.07E-02**	1.07E-01
Cer(d18:1/24:0)	0.080 (0.032-0.128)	**1.48E-03**	6.04E-02	0.023 (-0.015-0.061)	2.38E-01	5.06E-01	2.04 (-0.12-4.2)	6.71E-02	2.16E-01
Cer(d18:1/24:1)	0.035 (-0.015-0.086)	1.77E-01	4.02E-01	0.037 (-0.002-0.075)	6.34E-02	2.34E-01	2.72 (0.56-4.88)	**1.54E-02**	1.24E-01
HexCer(d18:1/16:0)	0.029 (-0.027-0.085)	3.10E-01	5.91E-01	0.045 (0.006-0.084)	**2.64E-02**	1.33E-01	2.63 (0.43-4.82)	**2.15E-02**	1.38E-01
HexCer(d18:1/18:0)	0.001 (-0.034-0.035)	9.66E-01	9.83E-01	0.024 (-0.002-0.05)	7.53E-02	2.61E-01	1.46 (-0.02-2.95)	5.73E-02	2.01E-01
HexCer(d18:1/20:0)	0.019 (-0.028-0.066)	4.27E-01	6.67E-01	0.045 (0.01-0.08)	**1.28E-02**	8.69E-02	1.61 (-0.45-3.66)	1.30E-01	2.82E-01
HexCer(d18:1/22:0)	0.052 (0.006-0.098)	**2.91E-02**	1.49E-01	0.025 (-0.011-0.061)	1.85E-01	4.33E-01	1.43 (-0.63-3.48)	1.77E-01	3.29E-01
HexCer(d18:1/24:0)	0.064 (0.008-0.119)	**2.74E-02**	1.45E-01	0.049 (0.008-0.091)	**2.14E-02**	1.19E-01	2.29 (-0.08-4.65)	6.15E-02	2.05E-01
HexCer(d18:1/24:1)	0.022 (-0.034-0.079)	4.45E-01	6.77E-01	0.056 (0.013-0.1)	**1.24E-02**	8.57E-02	2.02 (-0.51-4.55)	1.22E-01	2.73E-01
Hex2Cer(d18:1/16:0)	0.065 (0.016-0.114)	**1.08E-02**	7.98E-02	0.05 (0.014-0.086)	**8.21E-03**	6.96E-02	2.7 (0.62-4.77)	**1.26E-02**	1.22E-01
Hex2Cer(d18:1/18:0)	-0.024 (-0.061-0.013)	2.05E-01	4.44E-01	0.032 (0.004-0.061)	**2.89E-02**	1.36E-01	0.85 (-0.89-2.59)	3.41E-01	4.62E-01
Hex2Cer(d18:1/20:0)	0.022 (-0.026-0.070)	3.66E-01	6.40E-01	0.02 (-0.018-0.058)	3.00E-01	5.82E-01	0.65 (-1.52-2.81)	5.60E-01	6.46E-01
Hex2Cer(d18:1/22:0)	0.046 (0.003-0.089)	**3.93E-02**	1.71E-01	0.039 (0.009-0.07)	**1.36E-02**	9.04E-02	0.79 (-0.97-2.55)	3.81E-01	5.02E-01
Hex2Cer(d18:1/24:0)	0.051 (-0.007-0.109)	8.56E-02	2.66E-01	0.053 (0.011-0.095)	**1.53E-02**	9.42E-02	1.2 (-1.29-3.68)	3.47E-01	4.67E-01
Hex2Cer(d18:1/24:1)	0.049 (-0.006-0.103)	8.39E-02	2.63E-01	0.058 (0.019-0.097)	**4.30E-03**	**4.55E-02**	1.02 (-1.3-3.33)	3.91E-01	5.12E-01

Lipid species [a]	Log-Norepinephrine			Non-esterified fatty acids			Heart Rate		
	β-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]
Hex3Cer(d18:1/16:0)	0.053 (-0.001-0.106)	5.64E-02	2.06E-01	0.055 (0.012-0.098)	**1.43E-02**	9.35E-02	0.61 (-1.99-3.21)	6.46E-01	7.15E-01
Hex3Cer(d18:1/18:0)	0.036 (-0.009-0.081)	1.23E-01	3.25E-01	0.039 (0.004-0.074)	**3.19E-02**	1.43E-01	0.74 (-1.36-2.85)	4.90E-01	5.90E-01
Hex3Cer(d18:1/20:0)	0.088 (0.035-0.141)	**1.70E-03**	6.04E-02	0.031 (-0.013-0.075)	1.68E-01	4.04E-01	1.22 (-1.3-3.74)	3.46E-01	4.67E-01
Hex3Cer(d18:1/22:0)	0.065 (0.008-0.121)	**2.73E-02**	1.45E-01	0.032 (-0.01-0.074)	1.35E-01	3.56E-01	-0.01 (-2.43-2.42)	9.95E-01	9.95E-01
Hex3Cer(d18:1/24:0)	0.016 (-0.028-0.060)	4.84E-01	7.04E-01	0.028 (-0.005-0.06)	9.78E-02	2.88E-01	-0.09 (-1.97-1.78)	9.23E-01	9.43E-01
Hex3Cer(d18:1/24:1)	0.020 (-0.041-0.081)	5.19E-01	7.24E-01	0.035 (-0.01-0.079)	1.31E-01	3.50E-01	-0.54 (-3.11-2.03)	6.81E-01	7.47E-01
GM3(d18:1/16:0)	0.034 (-0.015-0.084)	1.79E-01	4.02E-01	0.048 (0.013-0.084)	**8.51E-03**	7.04E-02	2.44 (0.38-4.5)	**2.24E-02**	1.41E-01
GM3(d18:1/18:0)	0.036 (-0.023-0.096)	2.31E-01	4.75E-01	0.067 (0.025-0.109)	**2.43E-03**	**3.84E-02**	2.5 (0.02-4.98)	5.14E-02	1.99E-01
GM3(d18:1/20:0)	-0.015 (-0.056-0.026)	4.71E-01	6.99E-01	0.039 (0.008-0.071)	**1.69E-02**	1.01E-01	1.01 (-0.88-2.9)	2.97E-01	4.18E-01
GM3(d18:1/22:0)	0.041 (-0.014-0.096)	1.46E-01	3.63E-01	0.081 (0.041-0.12)	**1.26E-04**	**6.97E-03**	3.8 (1.56-6.04)	**1.30E-03**	5.23E-02
GM3(d18:1/24:0)	0.007 (-0.046-0.060)	7.98E-01	8.97E-01	0.051 (0.013-0.089)	**1.05E-02**	7.89E-02	0.58 (-1.8-2.96)	6.35E-01	7.10E-01
GM3(d18:1/24:1)	0.005 (-0.059-0.069)	8.84E-01	9.35E-01	0.067 (0.021-0.112)	**5.33E-03**	5.17E-02	3.33 (0.7-5.96)	**1.52E-02**	1.24E-01
SM(31:1)	0.073 (0.016-0.130)	**1.37E-02**	9.10E-02	0.048 (-0.01-0.106)	1.07E-01	3.05E-01	4.13 (0.88-7.38)	**1.46E-02**	1.24E-01
SM(32:0)	0.053 (-0.004-0.110)	7.15E-02	2.42E-01	0.051 (0.005-0.097)	**3.37E-02**	1.45E-01	3.8 (1.23-6.37)	**4.80E-03**	7.39E-02
SM(32:1)	0.073 (0.017-0.130)	**1.23E-02**	8.75E-02	0.054 (0.005-0.103)	**3.20E-02**	1.43E-01	3.73 (0.97-6.5)	**9.65E-03**	1.02E-01
SM(32:2)	0.097 (0.028-0.166)	**7.24E-03**	6.93E-02	0.117 (0.044-0.19)	**2.35E-03**	**3.84E-02**	3.18 (-1.11-7.46)	1.50E-01	3.05E-01
SM(33:1)	0.064 (0.011-0.117)	**2.08E-02**	1.26E-01	0.033 (-0.015-0.081)	1.83E-01	4.31E-01	3.8 (1.15-6.44)	**6.05E-03**	8.54E-02
SM(34:0)	0.073 (0.014-0.131)	**1.67E-02**	1.05E-01	0.025 (-0.021-0.071)	2.84E-01	5.63E-01	3.07 (0.47-5.67)	**2.30E-02**	1.41E-01
SM(34:1)	0.065 (0.016-0.114)	**1.07E-02**	7.98E-02	0.034 (-0.004-0.073)	8.70E-02	2.78E-01	2.53 (0.32-4.73)	**2.74E-02**	1.49E-01
SM(34:2)	0.090 (0.030-0.151)	**4.31E-03**	6.93E-02	0.09 (0.039-0.14)	**7.96E-04**	**1.80E-02**	2.78 (-0.23-5.79)	7.33E-02	2.16E-01
SM(34:3)	0.093 (0.034-0.151)	**2.67E-03**	6.04E-02	0.099 (0.049-0.15)	**1.93E-04**	**8.18E-03**	3.58 (0.52-6.64)	**2.42E-02**	1.44E-01
SM(35:1)	0.064 (0.010-0.117)	**2.13E-02**	1.27E-01	0.041 (-0.004-0.087)	7.85E-02	2.66E-01	4.14 (1.63-6.64)	**1.76E-03**	5.23E-02
SM(35:2)	0.083 (0.024-0.142)	**6.86E-03**	6.93E-02	0.07 (0.015-0.125)	**1.52E-02**	9.42E-02	5.21 (2.14-8.28)	**1.30E-03**	5.23E-02
SM(36:1)	0.031 (-0.023-0.085)	2.60E-01	5.21E-01	0.06 (0.021-0.099)	**3.41E-03**	**4.13E-02**	3.44 (1.33-5.56)	**2.00E-03**	5.23E-02
SM(36:2)	0.056 (-0.002-0.114)	6.15E-02	2.17E-01	0.077 (0.034-0.12)	**7.66E-04**	**1.80E-02**	3.7 (1.22-6.18)	**4.44E-03**	7.37E-02

Lipid species [a]	Log-Norepinephrine			Non-esterified fatty acids			Heart Rate		
	β-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]
SM(36:3)	0.090 (0.029-0.150)	**4.96E-03**	6.93E-02	0.103 (0.052-0.153)	**1.44E-04**	**6.97E-03**	4.55 (1.57-7.53)	**3.62E-03**	6.97E-02
SM(37:2)	0.091 (0.033-0.150)	**3.05E-03**	6.30E-02	0.073 (0.017-0.128)	**1.22E-02**	8.57E-02	5.68 (2.57-8.78)	**5.60E-04**	5.23E-02
SM(38:1)	0.046 (-0.005-0.097)	7.85E-02	2.51E-01	0.044 (0.006-0.082)	**2.46E-02**	1.27E-01	2.18 (0.04-4.32)	**4.93E-02**	1.95E-01
SM(38:2)	0.053 (0.002-0.104)	**4.44E-02**	1.77E-01	0.056 (0.019-0.092)	**3.54E-03**	**4.14E-02**	2.61 (0.49-4.74)	**1.79E-02**	1.27E-01
SM(39:1)	0.083 (0.029-0.136)	**3.17E-03**	6.30E-02	0.024 (-0.022-0.071)	3.09E-01	5.82E-01	3.14 (0.54-5.74)	**2.02E-02**	1.35E-01
SM(41:1)	0.069 (0.021-0.117)	**5.70E-03**	6.93E-02	0.02 (-0.019-0.06)	3.17E-01	5.88E-01	3.33 (1.19-5.48)	**3.12E-03**	6.61E-02
SM(41:2)	0.077 (0.023-0.131)	**6.55E-03**	6.93E-02	0.028 (-0.02-0.076)	2.50E-01	5.21E-01	2.93 (0.25-5.62)	**3.53E-02**	1.66E-01
SM(42:1)	0.059 (0.017-0.100)	**7.36E-03**	6.93E-02	0.02 (-0.014-0.054)	2.51E-01	5.21E-01	1.78 (-0.15-3.71)	7.42E-02	2.16E-01
PC(28:0)	0.041 (-0.017-0.099)	1.69E-01	3.94E-01	0.012 (-0.034-0.058)	6.10E-01	8.69E-01	1.06 (-1.57-3.69)	4.32E-01	5.43E-01
PC(29:0)	0.070 (0.019-0.122)	**9.18E-03**	7.69E-02	0.047 (0.006-0.087)	**2.75E-02**	1.33E-01	1.87 (-0.39-4.12)	1.08E-01	2.64E-01
PC(30:0)	0.043 (-0.015-0.100)	1.53E-01	3.67E-01	0.025 (-0.021-0.07)	2.95E-01	5.78E-01	2.19 (-0.37-4.75)	9.75E-02	2.50E-01
PC(31:0)	0.047 (-0.008-0.102)	1.00E-01	2.88E-01	0.014 (-0.032-0.059)	5.63E-01	8.27E-01	2.52 (-0.02-5.05)	5.54E-02	2.00E-01
PC(31:1)	0.068 (0.007-0.129)	**3.15E-02**	1.55E-01	0.057 (0.003-0.111)	**4.09E-02**	1.71E-01	5.21 (2.47-7.95)	**3.42E-04**	5.23E-02
PC(32:0)	0.045 (-0.010-0.099)	1.13E-01	3.09E-01	0.026 (-0.017-0.068)	2.37E-01	5.06E-01	2.51 (0.15-4.88)	**4.02E-02**	1.74E-01
PC(32:1)	0.011 (-0.048-0.069)	7.20E-01	8.78E-01	0.08 (0.039-0.121)	**2.44E-04**	**8.95E-03**	3.05 (0.45-5.65)	**2.38E-02**	1.44E-01
PC(32:2)	0.080 (0.025-0.135)	**5.22E-03**	6.93E-02	0.094 (0.051-0.136)	**4.82E-05**	**5.45E-03**	4.39 (1.72-7.06)	**1.81E-03**	5.23E-02
PC(32:3)	0.092 (0.034-0.150)	**2.51E-03**	6.04E-02	0.088 (0.039-0.137)	**6.55E-04**	**1.80E-02**	5.13 (2.19-8.07)	**9.77E-04**	5.23E-02
PC(33:0)	0.041 (-0.014-0.096)	1.51E-01	3.67E-01	0.029 (-0.015-0.072)	1.98E-01	4.54E-01	3.52 (1.28-5.76)	**2.78E-03**	6.27E-02
PC(33:1)	0.058 (0.004-0.112)	**3.99E-02**	1.71E-01	0.05 (0.005-0.095)	**3.08E-02**	1.41E-01	3.31 (0.71-5.91)	**1.44E-02**	1.24E-01
PC(33:2)	0.062 (0.011-0.112)	**1.88E-02**	1.16E-01	0.05 (0.006-0.093)	**2.71E-02**	1.33E-01	2.75 (0.27-5.23)	**3.27E-02**	1.61E-01
PC(33:3)	0.048 (-0.006-0.102)	8.79E-02	2.71E-01	0.037 (-0.009-0.082)	1.16E-01	3.23E-01	4.38 (1.87-6.89)	**9.56E-04**	5.23E-02
PC(34:0)	0.063 (0.014-0.112)	**1.35E-02**	9.10E-02	0.003 (-0.036-0.041)	8.95E-01	9.63E-01	1.99 (-0.14-4.13)	7.11E-02	2.16E-01
PC(34:1)	0.027 (-0.031-0.086)	3.58E-01	6.36E-01	0.041 (-0.004-0.085)	7.75E-02	2.65E-01	0.84 (-1.63-3.31)	5.08E-01	6.06E-01
PC(34:2)	0.023 (-0.025-0.071)	3.48E-01	6.35E-01	0.036 (0-0.071)	5.25E-02	2.02E-01	1.15 (-0.91-3.2)	2.77E-01	4.02E-01
PC(34:3)	0.036 (-0.009-0.082)	1.18E-01	3.18E-01	0.05 (0.016-0.085)	**5.66E-03**	5.33E-02	2.54 (0.54-4.54)	**1.48E-02**	1.24E-01

Lipid species [a]	Log-Norepinephrine			Non-esterified fatty acids			Heart Rate		
	β-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]
PC(34:4)	0.059 (0.007-0.112)	**2.89E-02**	1.49E-01	0.074 (0.033-0.116)	**6.89E-04**	**1.80E-02**	2.98 (0.54-5.42)	**1.90E-02**	1.29E-01
PC(34:5)	0.036 (-0.016-0.088)	1.76E-01	4.02E-01	0.009 (-0.032-0.05)	6.59E-01	8.81E-01	2.13 (-0.17-4.43)	7.36E-02	2.16E-01
PC(35:0)	0.074 (0.015-0.133)	**1.66E-02**	1.05E-01	-0.001 (-0.048-0.046)	9.77E-01	9.95E-01	4.45 (1.72-7.18)	**1.96E-03**	5.23E-02
PC(35:1)	0.066 (0.003-0.130)	**4.38E-02**	1.77E-01	0.018 (-0.036-0.072)	5.20E-01	7.85E-01	2.44 (-0.52-5.4)	1.10E-01	2.64E-01
PC(35:2)	0.066 (0.025-0.108)	**2.48E-03**	6.04E-02	0.031 (-0.005-0.066)	9.36E-02	2.83E-01	1.77 (-0.19-3.73)	8.03E-02	2.16E-01
PC(35:3)	0.057 (0.005-0.110)	**3.41E-02**	1.59E-01	0.052 (0.009-0.094)	**2.09E-02**	1.18E-01	2.26 (-0.23-4.75)	7.85E-02	2.16E-01
PC(35:4)	0.073 (0.020-0.125)	**8.30E-03**	7.54E-02	0.068 (0.024-0.111)	**2.99E-03**	**4.07E-02**	3.03 (0.55-5.51)	**1.90E-02**	1.29E-01
PC(36:0)	0.064 (0.018-0.111)	**8.45E-03**	7.54E-02	0 (-0.038-0.038)	9.95E-01	9.99E-01	1.81 (-0.12-3.74)	6.96E-02	2.16E-01
PC(36:1)	0.062 (0.005-0.119)	**3.61E-02**	1.63E-01	0.014 (-0.03-0.058)	5.24E-01	7.87E-01	1.48 (-1.11-4.07)	2.65E-01	3.95E-01
PC(36:2)	0.084 (0.036-0.131)	**8.70E-04**	5.90E-02	0.027 (-0.013-0.066)	1.88E-01	4.37E-01	1.27 (-0.99-3.52)	2.75E-01	4.02E-01
PC(36:3)	0.046 (0.004-0.088)	**3.46E-02**	1.59E-01	0.047 (0.016-0.078)	**4.00E-03**	**4.52E-02**	0.69 (-1.14-2.51)	4.63E-01	5.68E-01
PC(36:4)	0.036 (-0.013-0.085)	1.52E-01	3.67E-01	0.075 (0.039-0.111)	**9.61E-05**	**6.97E-03**	1.05 (-1.09-3.2)	3.40E-01	4.62E-01
PC(36:5)	0.005 (-0.051-0.060)	8.65E-01	9.34E-01	0.006 (-0.037-0.049)	7.81E-01	9.12E-01	2.01 (-0.39-4.4)	1.05E-01	2.57E-01
PC(36:6)	0.040 (-0.006-0.086)	9.19E-02	2.81E-01	0.025 (-0.013-0.062)	2.05E-01	4.57E-01	2.36 (0.32-4.41)	**2.61E-02**	1.49E-01
PC(37:4)	0.069 (0.021-0.117)	**6.00E-03**	6.93E-02	0.055 (0.016-0.093)	**6.38E-03**	5.85E-02	1.26 (-1.01-3.53)	2.81E-01	4.02E-01
PC(37:5)	0.034 (-0.016-0.085)	1.89E-01	4.19E-01	-0.01 (-0.05-0.031)	6.33E-01	8.77E-01	1.7 (-0.45-3.85)	1.24E-01	2.75E-01
PC(37:6)	0.059 (0.007-0.112)	**2.95E-02**	1.49E-01	0.022 (-0.022-0.066)	3.26E-01	5.98E-01	3.1 (0.67-5.53)	**1.44E-02**	1.24E-01
PC(38:2)	0.100 (0.040-0.160)	**1.57E-03**	6.04E-02	0.039 (-0.009-0.086)	1.14E-01	3.21E-01	2.7 (0.02-5.39)	5.17E-02	1.99E-01
PC(38:3)	0.051 (0.005-0.097)	**3.09E-02**	1.54E-01	0.039 (0.004-0.075)	**3.28E-02**	1.44E-01	2.21 (0.26-4.16)	**2.92E-02**	1.51E-01
PC(38:4)	0.066 (0.009-0.122)	**2.55E-02**	1.41E-01	0.057 (0.014-0.101)	**1.12E-02**	8.25E-02	1.75 (-0.76-4.27)	1.76E-01	3.29E-01
PC(38:5)	0.037 (-0.006-0.081)	9.77E-02	2.88E-01	0.03 (-0.005-0.064)	9.55E-02	2.85E-01	2.01 (0.13-3.89)	**3.95E-02**	1.74E-01
PC(38:6)	0.014 (-0.047-0.075)	6.56E-01	8.32E-01	0.01 (-0.036-0.056)	6.84E-01	8.83E-01	2.38 (-0.2-4.96)	7.41E-02	2.16E-01
PC(38:7)	0.007 (-0.056-0.070)	8.28E-01	9.12E-01	0.017 (-0.032-0.066)	4.94E-01	7.64E-01	1.72 (-0.95-4.39)	2.11E-01	3.61E-01
PC(39:5)	0.076 (0.024-0.128)	**5.05E-03**	6.93E-02	0.015 (-0.028-0.058)	5.02E-01	7.70E-01	3.19 (0.85-5.53)	**8.94E-03**	9.99E-02
PC(39:6)	0.063 (0.002-0.124)	**4.48E-02**	1.77E-01	-0.007 (-0.058-0.044)	7.89E-01	9.14E-01	2.17 (-0.74-5.09)	1.47E-01	3.05E-01

Lipid species [a]	Log-Norepinephrine			Non-esterified fatty acids			Heart Rate		
	β-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]
PC(39:7)	0.059 (-0.002-0.119)	6.03E-02	2.15E-01	0.01 (-0.039-0.059)	6.85E-01	8.83E-01	1.19 (-1.65-4.03)	4.13E-01	5.26E-01
PC(18:0/22:4)	0.033 (-0.020-0.086)	2.25E-01	4.73E-01	0.063 (0.023-0.103)	**2.53E-03**	**3.84E-02**	1.61 (-0.62-3.84)	1.61E-01	3.15E-01
PC(40:5)	0.044 (-0.012-0.100)	1.26E-01	3.31E-01	0.037 (-0.005-0.08)	8.82E-02	2.79E-01	3.32 (0.96-5.67)	**7.09E-03**	9.61E-02
PC(40:6)	0.033 (-0.021-0.087)	2.30E-01	4.75E-01	0.005 (-0.037-0.046)	8.29E-01	9.30E-01	2.06 (-0.2-4.33)	7.71E-02	2.16E-01
PC(40:7)	0.042 (-0.004-0.088)	7.59E-02	2.47E-01	0.016 (-0.02-0.053)	3.86E-01	6.63E-01	1.23 (-0.74-3.2)	2.24E-01	3.61E-01
PC(40:8)	0.064 (0.009-0.119)	**2.41E-02**	1.36E-01	0.022 (-0.021-0.064)	3.27E-01	5.98E-01	0.66 (-1.78-3.11)	5.97E-01	6.79E-01
PC(O-32:0)	0.085 (0.025-0.145)	**6.43E-03**	6.93E-02	0.099 (0.059-0.14)	**6.11E-06**	**2.07E-03**	4.01 (1.56-6.46)	**1.92E-03**	5.23E-02
PC(O-32:1)	0.050 (-0.004-0.103)	7.34E-02	2.44E-01	0.091 (0.052-0.13)	**1.62E-05**	**2.74E-03**	1.32 (-1.22-3.87)	3.11E-01	4.28E-01
PC(O-32:2)	0.008 (-0.039-0.054)	7.49E-01	8.85E-01	-0.019 (-0.055-0.016)	2.84E-01	5.63E-01	-0.69 (-2.76-1.38)	5.16E-01	6.14E-01
PC(O-34:1)	0.088 (0.025-0.150)	**7.08E-03**	6.93E-02	0.053 (0.008-0.099)	**2.48E-02**	1.27E-01	0.64 (-2.04-3.33)	6.39E-01	7.11E-01
PC(O-34:2)	0.073 (0.025-0.121)	**3.53E-03**	6.30E-02	0.025 (-0.012-0.062)	1.91E-01	4.41E-01	1.18 (-0.93-3.3)	2.76E-01	4.02E-01
PC(O-34:3)	0.043 (-0.012-0.099)	1.27E-01	3.31E-01	0.038 (-0.007-0.082)	1.03E-01	2.98E-01	4.46 (2.01-6.9)	**5.88E-04**	5.23E-02
PC(O-34:4)	0.044 (-0.012-0.100)	1.29E-01	3.32E-01	0.013 (-0.029-0.055)	5.33E-01	7.89E-01	0.19 (-2.21-2.58)	8.79E-01	9.08E-01
PC(O-35:4)	0.027 (-0.020-0.075)	2.65E-01	5.25E-01	0.046 (0.01-0.082)	**1.52E-02**	9.42E-02	2.84 (0.78-4.89)	**8.22E-03**	9.61E-02
PC(O-36:0)	0.048 (0.002-0.094)	**4.20E-02**	1.77E-01	0.009 (-0.027-0.045)	6.24E-01	8.69E-01	1.18 (-0.85-3.21)	2.58E-01	3.88E-01
PC(O-36:1)	0.091 (0.034-0.148)	**2.44E-03**	6.04E-02	0.059 (0.018-0.101)	**6.59E-03**	5.88E-02	1.71 (-0.89-4.31)	2.00E-01	3.55E-01
PC(O-36:2)	0.121 (0.065-0.176)	**5.20E-05**	**1.76E-02**	0.036 (-0.009-0.081)	1.23E-01	3.35E-01	0.77 (-1.82-3.36)	5.60E-01	6.46E-01
PC(O-36:3)	0.097 (0.043-0.151)	**6.75E-04**	5.90E-02	0.047 (0.004-0.089)	**3.31E-02**	1.44E-01	1.66 (-0.73-4.05)	1.78E-01	3.29E-01
PC(O-36:4)	0.069 (0.027-0.111)	**1.74E-03**	6.04E-02	0.037 (0.005-0.069)	**2.78E-02**	1.33E-01	1.33 (-0.51-3.18)	1.60E-01	3.15E-01
PC(O-36:5)	0.025 (-0.034-0.084)	4.15E-01	6.62E-01	-0.027 (-0.072-0.018)	2.44E-01	5.13E-01	1.56 (-1-4.13)	2.35E-01	3.66E-01
PC(O-38:4)	0.056 (0.015-0.098)	**9.48E-03**	7.69E-02	0.058 (0.03-0.087)	**1.08E-04**	**6.97E-03**	1.78 (0.07-3.5)	**4.46E-02**	1.83E-01
PC(O-38:5)	0.070 (0.015-0.125)	**1.46E-02**	9.51E-02	0.038 (-0.003-0.079)	7.40E-02	2.61E-01	0.73 (-1.64-3.11)	5.48E-01	6.41E-01
PC(O-40:5)	0.087 (0.040-0.135)	**5.24E-04**	5.90E-02	0.071 (0.034-0.107)	**2.64E-04**	**8.95E-03**	1.36 (-0.87-3.6)	2.35E-01	3.66E-01
PC(O-40:6)	0.091 (0.035-0.148)	**2.19E-03**	6.04E-02	0.047 (0.002-0.093)	**4.47E-02**	1.78E-01	4.04 (1.53-6.55)	**2.24E-03**	5.43E-02
PC(O-40:7)	0.068 (0.018-0.119)	**9.26E-03**	7.69E-02	0.007 (-0.034-0.049)	7.30E-01	9.05E-01	1.66 (-0.7-4.01)	1.71E-01	3.29E-01

Lipid species [a]	Log-Norepinephrine			Non-esterified fatty acids			Heart Rate		
	β-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]
PC(P-30:0)	0.083 (0.029-0.138)	**3.50E-03**	6.30E-02	0.065 (0.023-0.107)	**3.00E-03**	**4.07E-02**	1.71 (-0.78-4.2)	1.82E-01	3.32E-01
PC(P-32:0)	0.078 (0.023-0.133)	**6.45E-03**	6.93E-02	0.07 (0.03-0.11)	**9.91E-04**	**1.99E-02**	3.03 (0.68-5.38)	**1.34E-02**	1.24E-01
PC(P-32:1)	0.056 (0.005-0.107)	**3.26E-02**	1.57E-01	0.059 (0.023-0.095)	**1.84E-03**	**3.28E-02**	3.21 (1.24-5.18)	**1.95E-03**	5.23E-02
PC(P-34:1)	0.053 (-0.009-0.115)	9.88E-02	2.88E-01	0.065 (0.022-0.109)	**4.14E-03**	**4.52E-02**	-0.44 (-3.06-2.17)	7.41E-01	7.95E-01
PC(P-34:2)	0.060 (0.000-0.120)	5.17E-02	1.93E-01	0.034 (-0.009-0.077)	1.29E-01	3.46E-01	-0.21 (-2.7-2.29)	8.72E-01	9.04E-01
PC(P-34:3)	0.073 (0.011-0.136)	**2.41E-02**	1.36E-01	0.035 (-0.011-0.082)	1.35E-01	3.56E-01	-0.23 (-2.89-2.43)	8.67E-01	9.01E-01
PC(P-36:2)	0.078 (0.020-0.135)	**9.98E-03**	7.69E-02	0.03 (-0.012-0.072)	1.72E-01	4.10E-01	-0.67 (-3.09-1.76)	5.92E-01	6.78E-01
PC(P-36:4)	0.079 (0.026-0.132)	**4.23E-03**	6.93E-02	0.056 (0.018-0.093)	**5.07E-03**	5.06E-02	1.36 (-0.88-3.6)	2.37E-01	3.67E-01
PC(P-36:5)	0.024 (-0.034-0.083)	4.15E-01	6.62E-01	-0.021 (-0.065-0.023)	3.54E-01	6.39E-01	1.57 (-0.93-4.07)	2.22E-01	3.61E-01
PC(P-38:4)	0.065 (0.010-0.119)	**2.19E-02**	1.28E-01	0.059 (0.022-0.097)	**2.61E-03**	**3.84E-02**	1.63 (-0.59-3.86)	1.54E-01	3.06E-01
PC(P-38:5)	0.072 (0.018-0.125)	**9.85E-03**	7.69E-02	0.022 (-0.02-0.064)	3.05E-01	5.82E-01	1.45 (-0.92-3.81)	2.35E-01	3.66E-01
PC(P-38:6)	0.057 (-0.004-0.118)	7.04E-02	2.42E-01	0.012 (-0.035-0.06)	6.13E-01	8.69E-01	1.7 (-0.98-4.39)	2.18E-01	3.61E-01
PC(P-40:5)	0.075 (0.024-0.126)	**5.31E-03**	6.93E-02	0.03 (-0.011-0.07)	1.60E-01	3.95E-01	1.66 (-0.67-3.99)	1.67E-01	3.25E-01
PC(P-40:6)	0.074 (0.017-0.131)	**1.28E-02**	8.82E-02	0.022 (-0.024-0.068)	3.54E-01	6.39E-01	2.73 (0.14-5.32)	**4.21E-02**	1.78E-01
LPC(14:0)	0.021 (-0.023-0.064)	3.54E-01	6.36E-01	0.015 (-0.019-0.049)	3.86E-01	6.63E-01	1.8 (-0.19-3.78)	7.93E-02	2.16E-01
LPC(15:0)	0.035 (-0.024-0.094)	2.44E-01	4.99E-01	0.004 (-0.045-0.053)	8.76E-01	9.46E-01	3.16 (0.4-5.92)	**2.77E-02**	1.49E-01
LPC(16:0)	0.018 (-0.034-0.070)	5.05E-01	7.22E-01	0.027 (-0.017-0.071)	2.26E-01	4.90E-01	2.74 (0.32-5.16)	**2.93E-02**	1.51E-01
LPC(16:1)	-0.006 (-0.055-0.042)	8.03E-01	8.97E-01	0.055 (0.019-0.09)	**3.33E-03**	**4.13E-02**	1.75 (-0.4-3.91)	1.15E-01	2.67E-01
LPC(17:0)	0.055 (-0.009-0.119)	9.65E-02	2.88E-01	0.003 (-0.051-0.058)	9.12E-01	9.64E-01	3.48 (0.45-6.51)	**2.68E-02**	1.49E-01
LPC(17:1)	0.012 (-0.049-0.073)	7.10E-01	8.69E-01	0.02 (-0.03-0.07)	4.27E-01	6.93E-01	2.71 (-0.07-5.5)	5.98E-02	2.04E-01
LPC(18:0)	0.045 (-0.009-0.098)	1.04E-01	2.95E-01	0.003 (-0.04-0.045)	9.00E-01	9.64E-01	2.74 (0.39-5.09)	**2.48E-02**	1.45E-01
LPC(18:1)	0.018 (-0.034-0.070)	4.96E-01	7.12E-01	0.008 (-0.035-0.051)	7.08E-01	9.02E-01	0.94 (-1.51-3.38)	4.54E-01	5.64E-01
LPC(18:2)	0.028 (-0.023-0.079)	2.87E-01	5.60E-01	-0.001 (-0.041-0.04)	9.70E-01	9.95E-01	0.69 (-1.61-2.98)	5.59E-01	6.46E-01
LPC(18:3)	0.006 (-0.044-0.057)	8.06E-01	8.97E-01	0.006 (-0.033-0.045)	7.80E-01	9.12E-01	2 (-0.18-4.17)	7.56E-02	2.16E-01
LPC(20:0)	0.048 (-0.010-0.105)	1.09E-01	3.04E-01	-0.039 (-0.083-0.005)	8.91E-02	2.79E-01	1.01 (-1.53-3.55)	4.37E-01	5.46E-01

Lipid species [a]	Log-Norepinephrine			Non-esterified fatty acids			Heart Rate		
	β-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]
LPC(20:1)	0.018 (-0.037-0.073)	5.19E-01	7.24E-01	-0.034 (-0.075-0.006)	1.02E-01	2.98E-01	-0.2 (-2.48-2.08)	8.62E-01	8.99E-01
LPC(20:2)	0.019 (-0.025-0.062)	4.02E-01	6.61E-01	0.019 (-0.014-0.052)	2.60E-01	5.29E-01	0.55 (-1.29-2.4)	5.58E-01	6.46E-01
LPC(20:3)	0.017 (-0.027-0.061)	4.62E-01	6.90E-01	0.03 (-0.004-0.063)	9.11E-02	2.79E-01	0.86 (-1.06-2.78)	3.82E-01	5.02E-01
LPC(20:4)	0.015 (-0.031-0.060)	5.29E-01	7.32E-01	0.031 (-0.004-0.066)	9.05E-02	2.79E-01	0.89 (-1.15-2.92)	3.95E-01	5.13E-01
LPC(20:5)	-0.008 (-0.046-0.031)	6.96E-01	8.55E-01	-0.018 (-0.048-0.013)	2.57E-01	5.28E-01	1.07 (-0.65-2.8)	2.26E-01	3.62E-01
LPC(22:0)	0.056 (0.005-0.107)	**3.29E-02**	1.57E-01	-0.018 (-0.058-0.022)	3.87E-01	6.63E-01	1.36 (-0.89-3.62)	2.40E-01	3.69E-01
LPC(22:1)	-0.018 (-0.068-0.033)	4.93E-01	7.12E-01	-0.044 (-0.081--0.007)	**2.33E-02**	1.27E-01	0.68 (-1.43-2.79)	5.28E-01	6.26E-01
LPC(22:5)	0.011 (-0.034-0.055)	6.36E-01	8.23E-01	0.022 (-0.012-0.056)	2.09E-01	4.60E-01	1.97 (0.05-3.9)	**4.74E-02**	1.89E-01
LPC(22:6)	0.012 (-0.039-0.063)	6.38E-01	8.23E-01	0.007 (-0.034-0.048)	7.48E-01	9.08E-01	1.61 (-0.7-3.91)	1.76E-01	3.29E-01
LPC(24:0)	0.055 (0.003-0.107)	**4.30E-02**	1.77E-01	-0.019 (-0.06-0.022)	3.60E-01	6.44E-01	0.94 (-1.37-3.25)	4.29E-01	5.41E-01
LPC(26:0)	0.021 (-0.024-0.066)	3.59E-01	6.36E-01	-0.001 (-0.036-0.034)	9.45E-01	9.89E-01	0.66 (-1.39-2.72)	5.30E-01	6.26E-01
LPC(O-16:0)	0.038 (-0.022-0.098)	2.23E-01	4.72E-01	0.019 (-0.029-0.067)	4.38E-01	7.07E-01	2.67 (0.01-5.32)	5.27E-02	2.00E-01
LPC(O-18:0)	0.035 (-0.019-0.090)	2.09E-01	4.51E-01	0.002 (-0.04-0.045)	9.10E-01	9.64E-01	2.31 (-0.07-4.69)	6.03E-02	2.04E-01
LPC(O-18:1)	0.036 (-0.023-0.095)	2.31E-01	4.75E-01	-0.011 (-0.058-0.037)	6.57E-01	8.81E-01	0.58 (-2.12-3.28)	6.76E-01	7.44E-01
LPC(O-20:0)	0.005 (-0.022-0.031)	7.32E-01	8.84E-01	-0.003 (-0.024-0.019)	8.10E-01	9.24E-01	0.22 (-1.03-1.46)	7.33E-01	7.91E-01
LPC(O-20:1)	0.026 (-0.030-0.081)	3.72E-01	6.46E-01	0.001 (-0.044-0.046)	9.72E-01	9.95E-01	1.42 (-1.16-4.01)	2.84E-01	4.02E-01
LPC(O-22:0)	0.048 (-0.009-0.106)	1.05E-01	2.95E-01	0.015 (-0.031-0.061)	5.21E-01	7.85E-01	3.46 (0.96-5.96)	**8.04E-03**	9.61E-02
LPC(O-22:1)	0.027 (-0.034-0.088)	3.89E-01	6.60E-01	0 (-0.051-0.051)	9.99E-01	9.99E-01	0.28 (-2.62-3.18)	8.51E-01	8.91E-01
LPC(O-24:0)	0.031 (-0.018-0.079)	2.18E-01	4.65E-01	0.029 (-0.009-0.066)	1.39E-01	3.63E-01	2.2 (0.08-4.31)	**4.48E-02**	1.83E-01
LPC(O-24:1)	0.026 (-0.026-0.079)	3.29E-01	6.18E-01	0.029 (-0.01-0.069)	1.49E-01	3.77E-01	0.7 (-1.57-2.96)	5.49E-01	6.41E-01
LPC(O-24:2)	0.062 (0.008-0.115)	**2.61E-02**	1.42E-01	0.013 (-0.028-0.054)	5.49E-01	8.09E-01	1.45 (-0.87-3.78)	2.24E-01	3.61E-01
PE(32:0)	-0.026 (-0.072-0.019)	2.64E-01	5.25E-01	0.005 (-0.03-0.04)	7.79E-01	9.12E-01	0.43 (-1.55-2.41)	6.70E-01	7.40E-01
PE(32:1)	-0.045 (-0.105-0.015)	1.46E-01	3.63E-01	0.046 (-0.002-0.094)	6.51E-02	2.37E-01	0.73 (-2.09-3.55)	6.14E-01	6.94E-01
PE(34:1)	-0.032 (-0.085-0.022)	2.52E-01	5.10E-01	0.012 (-0.031-0.055)	5.92E-01	8.51E-01	-0.03 (-2.41-2.35)	9.80E-01	9.89E-01
PE(34:2)	-0.025 (-0.078-0.027)	3.48E-01	6.35E-01	0.013 (-0.028-0.055)	5.27E-01	7.87E-01	-0.11 (-2.46-2.25)	9.28E-01	9.44E-01

Lipid species [a]	Log-Norepinephrine			Non-esterified fatty acids			Heart Rate		
	β-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]
PE(34:3)	-0.015 (-0.065-0.034)	5.47E-01	7.48E-01	0.017 (-0.023-0.056)	4.05E-01	6.80E-01	0.84 (-1.59-3.27)	5.01E-01	6.00E-01
PE(35:1)	0.004 (-0.050-0.058)	8.83E-01	9.35E-01	0 (-0.044-0.043)	9.88E-01	9.97E-01	0.78 (-1.69-3.26)	5.37E-01	6.32E-01
PE(35:2)	0.008 (-0.057-0.073)	8.07E-01	8.97E-01	0.011 (-0.04-0.062)	6.65E-01	8.81E-01	0.81 (-2.18-3.81)	5.97E-01	6.79E-01
PE(36:0)	0.007 (-0.039-0.052)	7.80E-01	8.97E-01	0.016 (-0.02-0.051)	3.81E-01	6.63E-01	2.19 (0.21-4.16)	**3.31E-02**	1.61E-01
PE(36:1)	-0.004 (-0.062-0.054)	8.93E-01	9.35E-01	-0.009 (-0.055-0.038)	7.13E-01	9.02E-01	0.38 (-2.19-2.95)	7.75E-01	8.21E-01
PE(36:2)	-0.008 (-0.068-0.052)	8.02E-01	8.97E-01	0.01 (-0.036-0.057)	6.62E-01	8.81E-01	0.38 (-2.21-2.97)	7.75E-01	8.21E-01
PE(36:3)	-0.006 (-0.060-0.049)	8.39E-01	9.13E-01	0.003 (-0.039-0.045)	9.05E-01	9.64E-01	-0.47 (-2.86-1.93)	7.03E-01	7.67E-01
PE(36:4)	-0.022 (-0.073-0.030)	4.15E-01	6.62E-01	0.037 (-0.004-0.078)	7.97E-02	2.66E-01	-0.58 (-2.98-1.81)	6.33E-01	7.10E-01
PE(36:5)	-0.044 (-0.091-0.004)	7.69E-02	2.48E-01	-0.007 (-0.044-0.031)	7.31E-01	9.05E-01	-0.14 (-2.32-2.05)	9.01E-01	9.26E-01
PE(38:3)	0.003 (-0.046-0.052)	9.06E-01	9.39E-01	0.02 (-0.018-0.059)	3.06E-01	5.82E-01	0.46 (-1.75-2.66)	6.85E-01	7.49E-01
PE(38:4)	-0.006 (-0.058-0.045)	8.10E-01	8.97E-01	0.042 (0.002-0.083)	**4.47E-02**	1.78E-01	0.3 (-2.06-2.66)	8.02E-01	8.45E-01
PE(38:5)	-0.022 (-0.076-0.033)	4.41E-01	6.77E-01	0.018 (-0.025-0.062)	4.12E-01	6.85E-01	-0.02 (-2.6-2.55)	9.86E-01	9.89E-01
PE(38:6)	-0.018 (-0.071-0.036)	5.15E-01	7.24E-01	0.019 (-0.023-0.061)	3.82E-01	6.63E-01	0.24 (-2.15-2.63)	8.43E-01	8.85E-01
PE(40:4)	-0.002 (-0.047-0.043)	9.31E-01	9.57E-01	0.036 (-0.001-0.072)	5.79E-02	2.16E-01	0.37 (-1.67-2.41)	7.22E-01	7.85E-01
PE(40:5)	-0.007 (-0.058-0.044)	7.95E-01	8.97E-01	0.03 (-0.011-0.07)	1.52E-01	3.82E-01	0.29 (-2.01-2.6)	8.03E-01	8.45E-01
PE(40:6)	-0.018 (-0.080-0.044)	5.71E-01	7.63E-01	0.017 (-0.031-0.066)	4.82E-01	7.50E-01	1.67 (-1.07-4.41)	2.35E-01	3.66E-01
PE(40:7)	-0.009 (-0.065-0.046)	7.43E-01	8.85E-01	0.007 (-0.037-0.05)	7.60E-01	9.08E-01	-0.44 (-2.93-2.06)	7.33E-01	7.91E-01
PE(O-34:1)	0.049 (0.001-0.097)	**4.80E-02**	1.83E-01	-0.005 (-0.042-0.032)	7.93E-01	9.14E-01	1.54 (-0.54-3.61)	1.51E-01	3.05E-01
PE(O-34:2)	0.050 (-0.004-0.104)	7.22E-02	2.42E-01	-0.001 (-0.043-0.04)	9.48E-01	9.89E-01	1.38 (-0.97-3.74)	2.53E-01	3.82E-01
PE(O-36:2)	0.060 (0.004-0.116)	**3.87E-02**	1.70E-01	-0.004 (-0.047-0.039)	8.59E-01	9.44E-01	1.46 (-0.97-3.89)	2.41E-01	3.69E-01
PE(O-36:3)	0.041 (-0.010-0.092)	1.16E-01	3.16E-01	0.001 (-0.04-0.041)	9.73E-01	9.95E-01	1.5 (-0.87-3.87)	2.17E-01	3.61E-01
PE(O-36:4)	0.045 (-0.008-0.097)	1.00E-01	2.88E-01	-0.004 (-0.045-0.036)	8.33E-01	9.32E-01	1.54 (-0.72-3.8)	1.86E-01	3.37E-01
PE(O-36:5)	0.006 (-0.038-0.049)	8.05E-01	8.97E-01	-0.024 (-0.056-0.008)	1.41E-01	3.64E-01	1.16 (-0.71-3.03)	2.26E-01	3.62E-01
PE(O-36:6)	0.039 (-0.016-0.095)	1.68E-01	3.94E-01	-0.039 (-0.081-0.003)	7.54E-02	2.61E-01	2.38 (-0.02-4.78)	5.55E-02	2.00E-01
PE(O-38:4)	0.042 (-0.002-0.086)	6.57E-02	2.30E-01	0.009 (-0.026-0.044)	6.18E-01	8.69E-01	1.79 (-0.19-3.76)	7.96E-02	2.16E-01

Lipid species [a]	Log-Norepinephrine			Non-esterified fatty acids			Heart Rate		
	β-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]
PE(O-38:5)	0.045 (-0.008-0.097)	9.77E-02	2.88E-01	-0.007 (-0.047-0.033)	7.34E-01	9.05E-01	1.44 (-0.84-3.73)	2.18E-01	3.61E-01
PE(O-40:5)	0.059 (0.002-0.117)	**4.65E-02**	1.81E-01	0.008 (-0.035-0.051)	7.12E-01	9.02E-01	2.41 (-0.01-4.82)	5.40E-02	2.00E-01
PE(O-40:6)	0.020 (-0.034-0.073)	4.75E-01	6.99E-01	0 (-0.043-0.043)	9.85E-01	9.97E-01	1.13 (-1.32-3.58)	3.70E-01	4.90E-01
PE(O-40:7)	0.039 (-0.013-0.091)	1.48E-01	3.65E-01	-0.019 (-0.058-0.021)	3.61E-01	6.44E-01	0.57 (-1.62-2.75)	6.12E-01	6.94E-01
PE(P-34:1)	0.087 (0.038-0.136)	**7.55E-04**	5.90E-02	0.023 (-0.016-0.061)	2.56E-01	5.28E-01	1.1 (-1.14-3.34)	3.38E-01	4.62E-01
PE(P-34:2)	0.054 (0.005-0.104)	**3.46E-02**	1.59E-01	0.009 (-0.028-0.047)	6.21E-01	8.69E-01	1.38 (-0.77-3.54)	2.11E-01	3.61E-01
PE(P-36:1)	0.048 (-0.003-0.100)	7.10E-02	2.42E-01	0.015 (-0.025-0.054)	4.66E-01	7.34E-01	2.06 (-0.18-4.31)	7.56E-02	2.16E-01
PE(P-36:2)	0.073 (0.017-0.130)	**1.24E-02**	8.75E-02	0.019 (-0.024-0.061)	3.87E-01	6.63E-01	1.88 (-0.48-4.23)	1.22E-01	2.73E-01
PE(P-36:4)	0.041 (-0.012-0.095)	1.35E-01	3.43E-01	0.012 (-0.031-0.056)	5.73E-01	8.33E-01	1.96 (-0.46-4.39)	1.17E-01	2.67E-01
PE(P-38:4)	0.056 (0.002-0.111)	**4.69E-02**	1.81E-01	0.026 (-0.014-0.067)	2.04E-01	4.57E-01	1.93 (-0.35-4.22)	1.01E-01	2.51E-01
PE(P-38:5)	0.036 (-0.019-0.092)	2.04E-01	4.44E-01	-0.004 (-0.046-0.039)	8.65E-01	9.44E-01	2.14 (-0.23-4.52)	8.02E-02	2.16E-01
PE(P-38:6)	0.029 (-0.022-0.079)	2.73E-01	5.35E-01	0.002 (-0.037-0.041)	9.22E-01	9.71E-01	2.02 (-0.16-4.19)	7.26E-02	2.16E-01
PE(P-40:4)	0.030 (-0.017-0.077)	2.14E-01	4.59E-01	0.015 (-0.021-0.051)	4.23E-01	6.93E-01	0.86 (-1.19-2.91)	4.12E-01	5.26E-01
PE(P-40:5)	0.044 (-0.007-0.096)	9.72E-02	2.88E-01	0.006 (-0.032-0.045)	7.55E-01	9.08E-01	2.38 (0.24-4.51)	**3.19E-02**	1.61E-01
PE(P-40:6)	0.024 (-0.038-0.086)	4.55E-01	6.86E-01	0.01 (-0.037-0.057)	6.77E-01	8.83E-01	3.24 (0.63-5.85)	**1.71E-02**	1.27E-01
LPE(16:0)	-0.006 (-0.057-0.045)	8.26E-01	9.12E-01	0.015 (-0.025-0.054)	4.68E-01	7.34E-01	1.53 (-0.9-3.95)	2.21E-01	3.61E-01
LPE(18:0)	0.022 (-0.030-0.075)	4.06E-01	6.62E-01	0.017 (-0.023-0.058)	4.05E-01	6.80E-01	1.69 (-0.55-3.93)	1.43E-01	3.00E-01
LPE(18:1)	0.012 (-0.045-0.070)	6.76E-01	8.37E-01	0.007 (-0.039-0.052)	7.70E-01	9.12E-01	0.38 (-2.21-2.96)	7.74E-01	8.21E-01
LPE(18:2)	0.017 (-0.042-0.076)	5.68E-01	7.61E-01	0.028 (-0.018-0.074)	2.39E-01	5.07E-01	0.77 (-1.88-3.42)	5.71E-01	6.56E-01
LPE(20:4)	0.013 (-0.040-0.066)	6.38E-01	8.23E-01	0.067 (0.029-0.106)	**9.98E-04**	**1.99E-02**	1.08 (-1.26-3.42)	3.69E-01	4.90E-01
LPE(22:6)	0.030 (-0.029-0.089)	3.28E-01	6.18E-01	0.05 (0.004-0.096)	**3.66E-02**	1.55E-01	2.81 (0.24-5.39)	**3.53E-02**	1.66E-01
PI(32:0)	-0.005 (-0.071-0.062)	8.93E-01	9.35E-01	0.034 (-0.017-0.084)	2.00E-01	4.55E-01	2.22 (-0.69-5.13)	1.38E-01	2.96E-01
PI(32:1)	-0.007 (-0.073-0.059)	8.33E-01	9.13E-01	0.066 (0.018-0.115)	**9.03E-03**	7.12E-02	1.97 (-0.89-4.84)	1.80E-01	3.30E-01
PI(34:0)	-0.029 (-0.079-0.020)	2.53E-01	5.10E-01	-0.016 (-0.054-0.023)	4.26E-01	6.93E-01	-0.77 (-2.95-1.41)	4.91E-01	5.90E-01
PI(34:1)	0.012 (-0.042-0.066)	6.70E-01	8.37E-01	0.038 (-0.003-0.078)	7.01E-02	2.50E-01	1.65 (-0.69-4)	1.70E-01	3.29E-01

Lipid species [a]	Log-Norepinephrine			Non-esterified fatty acids			Heart Rate		
	β-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]
PI(36:1)	0.029 (-0.018-0.077)	2.27E-01	4.75E-01	0.005 (-0.032-0.042)	7.83E-01	9.12E-01	1.28 (-0.86-3.42)	2.43E-01	3.70E-01
PI(36:2)	0.053 (0.003-0.102)	**3.87E-02**	1.70E-01	0.035 (-0.004-0.073)	8.48E-02	2.74E-01	2.74 (0.56-4.93)	**1.60E-02**	1.26E-01
PI(36:3)	0.038 (-0.017-0.092)	1.78E-01	4.02E-01	0.043 (0-0.085)	5.37E-02	2.05E-01	2.64 (0.18-5.09)	**3.83E-02**	1.73E-01
PI(36:4)	0.026 (-0.038-0.090)	4.33E-01	6.73E-01	0.059 (0.01-0.107)	**1.94E-02**	1.13E-01	3.23 (0.61-5.85)	**1.77E-02**	1.27E-01
PI(38:2)	0.019 (-0.029-0.067)	4.44E-01	6.77E-01	0.047 (0.011-0.083)	**1.17E-02**	8.42E-02	1.55 (-0.56-3.66)	1.53E-01	3.05E-01
PI(38:3)	0.026 (-0.027-0.079)	3.32E-01	6.18E-01	0.046 (0.007-0.085)	**2.38E-02**	1.27E-01	2.23 (-0.01-4.48)	5.47E-02	2.00E-01
PI(38:4)	0.023 (-0.026-0.073)	3.62E-01	6.40E-01	0.066 (0.03-0.102)	**5.49E-04**	**1.69E-02**	2.84 (0.73-4.95)	**9.90E-03**	1.02E-01
PI(38:5)	0.048 (-0.006-0.102)	8.29E-02	2.63E-01	0.035 (-0.008-0.079)	1.17E-01	3.23E-01	2.59 (0.18-5)	**3.81E-02**	1.73E-01
PI(38:6)	0.009 (-0.043-0.061)	7.30E-01	8.84E-01	0.008 (-0.033-0.048)	7.13E-01	9.02E-01	2.19 (-0.1-4.49)	6.47E-02	2.11E-01
PI(40:4)	0.001 (-0.048-0.049)	9.75E-01	9.89E-01	0.058 (0.02-0.096)	**3.25E-03**	**4.13E-02**	1.8 (-0.41-4)	1.14E-01	2.66E-01
PI(40:5)	0.009 (-0.056-0.075)	7.81E-01	8.97E-01	0.051 (0.003-0.1)	**4.13E-02**	1.71E-01	3.84 (1.02-6.67)	**9.13E-03**	9.99E-02
PI(40:6)	0.000 (-0.053-0.052)	9.95E-01	9.96E-01	0.018 (-0.022-0.058)	3.72E-01	6.60E-01	2.1 (-0.26-4.45)	8.43E-02	2.25E-01
LPI(18:0)	0.016 (-0.032-0.064)	5.12E-01	7.24E-01	0.013 (-0.023-0.049)	4.73E-01	7.39E-01	1.94 (-0.08-3.96)	6.36E-02	2.09E-01
LPI(18:1)	0.057 (0.003-0.112)	**4.23E-02**	1.77E-01	-0.001 (-0.044-0.043)	9.77E-01	9.95E-01	1.33 (-1.18-3.85)	3.02E-01	4.22E-01
LPI(18:2)	0.077 (0.024-0.131)	**6.04E-03**	6.93E-02	0.04 (-0.004-0.084)	8.08E-02	2.66E-01	2.49 (-0.04-5.02)	5.74E-02	2.01E-01
LPI(20:4)	0.028 (-0.023-0.079)	2.89E-01	5.60E-01	0.052 (0.013-0.09)	**9.50E-03**	7.32E-02	2.5 (0.29-4.71)	**2.95E-02**	1.51E-01
PG(34:1)	0.003 (-0.056-0.062)	9.11E-01	9.41E-01	0.004 (-0.042-0.05)	8.58E-01	9.44E-01	0.43 (-2.1-2.97)	7.38E-01	7.94E-01
PG(36:1)	-0.003 (-0.052-0.046)	9.04E-01	9.39E-01	0.022 (-0.017-0.06)	2.78E-01	5.62E-01	0.85 (-1.38-3.07)	4.58E-01	5.65E-01
PG(36:2)	0.000 (-0.049-0.049)	9.91E-01	9.96E-01	0.007 (-0.03-0.045)	7.08E-01	9.02E-01	0.13 (-1.97-2.23)	9.06E-01	9.28E-01
Cholesterol	0.078 (0.030-0.127)	**2.11E-03**	6.04E-02	0.047 (0.008-0.085)	**2.06E-02**	1.18E-01	2.36 (0.14-4.57)	**4.03E-02**	1.74E-01
CE(14:0)	-0.008 (-0.058-0.043)	7.70E-01	8.95E-01	0.02 (-0.019-0.06)	3.17E-01	5.88E-01	1.82 (-0.45-4.1)	1.20E-01	2.70E-01
CE(15:0)	0.022 (-0.028-0.071)	3.94E-01	6.61E-01	0.022 (-0.016-0.061)	2.60E-01	5.29E-01	1.48 (-0.76-3.73)	1.99E-01	3.55E-01
CE(16:0)	0.020 (-0.026-0.067)	3.99E-01	6.61E-01	0.014 (-0.023-0.051)	4.66E-01	7.34E-01	1.38 (-0.69-3.44)	1.94E-01	3.50E-01
CE(16:1)	-0.014 (-0.068-0.041)	6.19E-01	8.11E-01	0.06 (0.019-0.101)	**4.87E-03**	5.00E-02	1.34 (-1.08-3.76)	2.80E-01	4.02E-01
CE(16:2)	0.019 (-0.035-0.073)	4.94E-01	7.12E-01	0.03 (-0.01-0.071)	1.48E-01	3.77E-01	2.88 (0.54-5.22)	**1.80E-02**	1.27E-01

Lipid species [a]	Log-Norepinephrine			Non-esterified fatty acids			Heart Rate		
	β-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]
CE(17:0)	0.037 (-0.012-0.086)	1.39E-01	3.51E-01	0.013 (-0.026-0.051)	5.13E-01	7.80E-01	1.38 (-0.8-3.56)	2.18E-01	3.61E-01
CE(17:1)	0.000 (-0.061-0.061)	9.96E-01	9.96E-01	0.047 (0.001-0.094)	**4.82E-02**	1.88E-01	0.95 (-1.72-3.61)	4.89E-01	5.90E-01
CE(18:0)	0.056 (-0.001-0.113)	5.96E-02	2.15E-01	0.017 (-0.027-0.061)	4.58E-01	7.34E-01	3.45 (1.05-5.85)	**6.00E-03**	8.54E-02
CE(18:1)	0.020 (-0.035-0.075)	4.73E-01	6.99E-01	0.031 (-0.012-0.075)	1.61E-01	3.96E-01	0.62 (-1.94-3.19)	6.36E-01	7.10E-01
CE(18:2)	0.024 (-0.032-0.080)	3.98E-01	6.61E-01	0.023 (-0.021-0.068)	3.07E-01	5.82E-01	1.38 (-1.24-4.01)	3.03E-01	4.22E-01
CE(18:3)	0.026 (-0.028-0.079)	3.56E-01	6.36E-01	0.039 (-0.002-0.081)	6.61E-02	2.38E-01	2.24 (-0.13-4.61)	6.78E-02	2.16E-01
CE(20:1)	0.005 (-0.053-0.062)	8.73E-01	9.35E-01	0 (-0.046-0.045)	9.89E-01	9.97E-01	1.46 (-1.19-4.11)	2.83E-01	4.02E-01
CE(20:2)	0.055 (0.000-0.109)	5.23E-02	1.93E-01	0.036 (-0.007-0.078)	1.07E-01	3.05E-01	1.61 (-0.9-4.13)	2.12E-01	3.61E-01
CE(20:3)	0.020 (-0.039-0.079)	5.13E-01	7.24E-01	0.052 (0.006-0.097)	**2.76E-02**	1.33E-01	1.57 (-1.14-4.27)	2.59E-01	3.88E-01
CE(20:4)	0.024 (-0.030-0.078)	3.89E-01	6.60E-01	0.047 (0.005-0.09)	**3.08E-02**	1.41E-01	2.24 (-0.31-4.78)	8.90E-02	2.34E-01
CE(20:5)	0.015 (-0.041-0.072)	5.97E-01	7.85E-01	0.002 (-0.042-0.046)	9.29E-01	9.75E-01	2.88 (0.47-5.28)	**2.15E-02**	1.38E-01
CE(22:0)	0.008 (-0.046-0.063)	7.64E-01	8.95E-01	0.012 (-0.031-0.055)	5.87E-01	8.47E-01	1.52 (-0.93-3.97)	2.28E-01	3.62E-01
CE(22:1)	-0.006 (-0.068-0.055)	8.38E-01	9.13E-01	-0.004 (-0.05-0.042)	8.63E-01	9.44E-01	1.14 (-1.55-3.83)	4.08E-01	5.24E-01
CE(22:4)	0.023 (-0.033-0.079)	4.25E-01	6.67E-01	0.061 (0.018-0.104)	**6.99E-03**	6.07E-02	0.67 (-1.93-3.27)	6.16E-01	6.94E-01
CE(22:5)	0.025 (-0.031-0.082)	3.82E-01	6.58E-01	0.038 (-0.006-0.082)	9.14E-02	2.79E-01	2.59 (0.09-5.09)	**4.52E-02**	1.83E-01
CE(22:6)	0.033 (-0.030-0.096)	3.06E-01	5.86E-01	0.02 (-0.028-0.068)	4.10E-01	6.85E-01	2.72 (-0.06-5.51)	5.87E-02	2.03E-01
CE(24:0)	0.012 (-0.047-0.070)	6.96E-01	8.55E-01	0.019 (-0.026-0.064)	4.04E-01	6.80E-01	1.49 (-1.14-4.12)	2.71E-01	4.02E-01
CE(24:1)	0.020 (-0.044-0.083)	5.42E-01	7.44E-01	0.011 (-0.037-0.06)	6.50E-01	8.81E-01	1.28 (-1.47-4.03)	3.65E-01	4.87E-01
CE(24:4)	0.020 (-0.030-0.070)	4.37E-01	6.77E-01	0.039 (-0.001-0.079)	5.74E-02	2.16E-01	1.21 (-1.1-3.52)	3.06E-01	4.24E-01
CE(24:5)	0.022 (-0.023-0.067)	3.35E-01	6.20E-01	0.006 (-0.029-0.041)	7.31E-01	9.05E-01	0.88 (-1.16-2.92)	4.01E-01	5.19E-01
CE(24:6)	0.022 (-0.038-0.082)	4.78E-01	6.99E-01	0.035 (-0.012-0.081)	1.47E-01	3.77E-01	2.86 (0.16-5.56)	**4.06E-02**	1.74E-01
DG(14:0_16:0)	-0.015 (-0.067-0.037)	5.79E-01	7.68E-01	-0.001 (-0.043-0.04)	9.54E-01	9.89E-01	1 (-1.33-3.34)	4.03E-01	5.19E-01
DG(14:0_18:1)	0.005 (-0.056-0.065)	8.79E-01	9.35E-01	0.007 (-0.039-0.054)	7.56E-01	9.08E-01	2.26 (-0.32-4.84)	9.00E-02	2.35E-01
DG(14:0_18:2)	0.019 (-0.043-0.081)	5.50E-01	7.49E-01	0.005 (-0.041-0.052)	8.24E-01	9.30E-01	2.08 (-0.51-4.68)	1.20E-01	2.70E-01
DG(16:0_16:0)	-0.019 (-0.064-0.027)	4.21E-01	6.66E-01	0.01 (-0.027-0.047)	6.09E-01	8.69E-01	1.27 (-0.73-3.27)	2.17E-01	3.61E-01

Lipid species [a]	Log-Norepinephrine			Non-esterified fatty acids			Heart Rate		
	β-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]
DG(16:0_18:0)	-0.003 (-0.037-0.031)	8.51E-01	9.21E-01	0 (-0.027-0.027)	9.99E-01	9.99E-01	-0.24 (-1.71-1.23)	7.50E-01	8.02E-01
DG(16:0_18:1)	-0.002 (-0.055-0.052)	9.53E-01	9.73E-01	0.021 (-0.02-0.063)	3.11E-01	5.82E-01	2.08 (-0.27-4.42)	8.67E-02	2.30E-01
DG(16:0_18:2)	0.015 (-0.050-0.080)	6.52E-01	8.30E-01	0.016 (-0.033-0.065)	5.31E-01	7.89E-01	2.73 (-0.05-5.51)	5.77E-02	2.01E-01
DG(16:0_20:0)	0.033 (-0.007-0.072)	1.10E-01	3.04E-01	0.003 (-0.028-0.033)	8.56E-01	9.44E-01	0.02 (-1.72-1.75)	9.85E-01	9.89E-01
DG(16:0_20:3)	-0.004 (-0.063-0.055)	9.02E-01	9.39E-01	0.053 (0.008-0.098)	**2.48E-02**	1.27E-01	1.85 (-0.8-4.5)	1.75E-01	3.29E-01
DG(16:0_20:4)	-0.006 (-0.062-0.050)	8.41E-01	9.13E-01	0.029 (-0.015-0.072)	2.03E-01	4.57E-01	1.5 (-1-4.01)	2.41E-01	3.69E-01
DG(16:0_22:5)	-0.016 (-0.078-0.047)	6.26E-01	8.16E-01	0.016 (-0.031-0.064)	5.05E-01	7.70E-01	2.2 (-0.46-4.87)	1.09E-01	2.64E-01
DG(16:0_22:6)	-0.003 (-0.062-0.056)	9.20E-01	9.48E-01	0.004 (-0.041-0.049)	8.69E-01	9.44E-01	1.33 (-1.24-3.9)	3.15E-01	4.32E-01
DG(16:1_18:0)	-0.019 (-0.065-0.027)	4.16E-01	6.62E-01	0.027 (-0.011-0.065)	1.68E-01	4.04E-01	1.51 (-0.66-3.67)	1.76E-01	3.29E-01
DG(16:1_18:1)	-0.004 (-0.055-0.048)	8.92E-01	9.35E-01	0.043 (0.002-0.084)	**4.43E-02**	1.78E-01	1.76 (-0.61-4.13)	1.49E-01	3.05E-01
DG(18:0_18:0)	0.006 (-0.034-0.047)	7.67E-01	8.95E-01	0.004 (-0.028-0.035)	8.10E-01	9.24E-01	-0.65 (-2.38-1.08)	4.65E-01	5.70E-01
DG(18:0_18:1)	-0.002 (-0.053-0.050)	9.46E-01	9.68E-01	0.009 (-0.032-0.049)	6.77E-01	8.83E-01	1.49 (-0.78-3.76)	2.01E-01	3.55E-01
DG(18:0_18:2)	0.013 (-0.042-0.067)	6.48E-01	8.29E-01	0.004 (-0.039-0.046)	8.67E-01	9.44E-01	1.8 (-0.63-4.23)	1.49E-01	3.05E-01
DG(18:0_20:4)	0.023 (-0.033-0.079)	4.23E-01	6.67E-01	0.01 (-0.033-0.053)	6.49E-01	8.81E-01	0.96 (-1.49-3.42)	4.45E-01	5.54E-01
DG(18:1_18:1)	0.010 (-0.047-0.068)	7.33E-01	8.84E-01	0.024 (-0.02-0.068)	2.83E-01	5.63E-01	1.6 (-0.91-4.11)	2.14E-01	3.61E-01
DG(18:1_18:2)	0.030 (-0.034-0.093)	3.58E-01	6.36E-01	0.023 (-0.024-0.069)	3.41E-01	6.22E-01	1.95 (-0.69-4.58)	1.51E-01	3.05E-01
DG(18:1_18:3)	0.032 (-0.027-0.092)	2.92E-01	5.63E-01	0.012 (-0.035-0.058)	6.25E-01	8.69E-01	2.11 (-0.5-4.73)	1.16E-01	2.67E-01
DG(18:1_20:0)	0.026 (-0.011-0.064)	1.73E-01	4.02E-01	-0.003 (-0.032-0.027)	8.59E-01	9.44E-01	-0.07 (-1.68-1.54)	9.31E-01	9.45E-01
DG(18:1_20:3)	0.014 (-0.033-0.060)	5.61E-01	7.55E-01	0.037 (0.001-0.072)	**4.80E-02**	1.88E-01	0.79 (-1.28-2.86)	4.57E-01	5.65E-01
DG(18:1_20:4)	0.035 (-0.012-0.081)	1.49E-01	3.65E-01	0.028 (-0.008-0.065)	1.28E-01	3.46E-01	1.31 (-0.71-3.34)	2.08E-01	3.61E-01
DG(18:2_18:2)	0.044 (-0.016-0.103)	1.55E-01	3.71E-01	0.024 (-0.02-0.068)	2.90E-01	5.72E-01	1.92 (-0.69-4.53)	1.53E-01	3.05E-01
TG(14:0_16:0_18:1)	-0.011 (-0.073-0.052)	7.42E-01	8.85E-01	-0.01 (-0.059-0.038)	6.82E-01	8.83E-01	1.46 (-1.28-4.21)	2.99E-01	4.19E-01
TG(14:0_16:0_18:2)	-0.017 (-0.074-0.040)	5.61E-01	7.55E-01	0.017 (-0.028-0.061)	4.60E-01	7.34E-01	1.96 (-0.55-4.46)	1.29E-01	2.82E-01
TG(14:0_16:1_18:1)	0.007 (-0.038-0.051)	7.71E-01	8.95E-01	-0.003 (-0.038-0.031)	8.59E-01	9.44E-01	1.29 (-0.7-3.27)	2.08E-01	3.61E-01
TG(14:0_16:1_18:2)	0.020 (-0.031-0.071)	4.50E-01	6.81E-01	-0.006 (-0.044-0.033)	7.73E-01	9.12E-01	1.7 (-0.37-3.77)	1.12E-01	2.65E-01

Lipid species [a]	Log-Norepinephrine			Non-esterified fatty acids			Heart Rate		
	β-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]
TG(14:0_17:0_18:1)	-0.008 (-0.063-0.048)	7.87E-01	8.97E-01	-0.009 (-0.051-0.032)	6.62E-01	8.81E-01	1.8 (-0.61-4.22)	1.46E-01	3.05E-01
TG(14:0_18:0_18:1)	-0.022 (-0.082-0.038)	4.79E-01	6.99E-01	-0.021 (-0.067-0.026)	3.87E-01	6.63E-01	1.02 (-1.48-3.52)	4.27E-01	5.40E-01
TG(14:0_18:2_18:2)	0.023 (-0.033-0.080)	4.16E-01	6.62E-01	-0.018 (-0.059-0.023)	3.94E-01	6.72E-01	2.24 (-0.08-4.55)	6.17E-02	2.05E-01
TG(14:1_16:0_18:1)	-0.009 (-0.066-0.047)	7.48E-01	8.85E-01	0.01 (-0.034-0.054)	6.65E-01	8.81E-01	1.65 (-0.9-4.2)	2.07E-01	3.61E-01
TG(14:1_16:1_18:0)	-0.023 (-0.076-0.031)	4.07E-01	6.62E-01	0.036 (-0.004-0.077)	8.37E-02	2.73E-01	2.09 (-0.33-4.5)	9.43E-02	2.44E-01
TG(14:1_18:0_18:2)	0.019 (-0.023-0.061)	3.75E-01	6.48E-01	0.01 (-0.024-0.043)	5.73E-01	8.33E-01	1.74 (-0.19-3.66)	8.03E-02	2.16E-01
TG(14:1_18:1_18:1)	0.006 (-0.040-0.052)	7.92E-01	8.97E-01	0.01 (-0.025-0.045)	5.76E-01	8.34E-01	1.68 (-0.3-3.67)	1.01E-01	2.51E-01
TG(15:0_16:0_18:1)	0.001 (-0.057-0.059)	9.80E-01	9.92E-01	0.007 (-0.037-0.051)	7.53E-01	9.08E-01	2.27 (-0.24-4.79)	7.97E-02	2.16E-01
TG(15:0_18:1_18:1)	0.021 (-0.026-0.068)	3.87E-01	6.60E-01	-0.008 (-0.043-0.027)	6.47E-01	8.81E-01	1.42 (-0.61-3.45)	1.74E-01	3.29E-01
TG(16:0_16:0_16:0)	-0.044 (-0.109-0.021)	1.84E-01	4.10E-01	0.013 (-0.039-0.066)	6.23E-01	8.69E-01	1.67 (-1.33-4.67)	2.78E-01	4.02E-01
TG(16:0_16:0_18:0)	-0.029 (-0.088-0.029)	3.31E-01	6.18E-01	0.008 (-0.041-0.057)	7.48E-01	9.08E-01	1.69 (-1-4.39)	2.22E-01	3.61E-01
TG(16:0_16:0_18:1)	-0.022 (-0.087-0.044)	5.17E-01	7.24E-01	0.01 (-0.042-0.061)	7.15E-01	9.02E-01	1.18 (-1.69-4.05)	4.21E-01	5.35E-01
TG(16:0_16:0_18:2)	-0.017 (-0.078-0.043)	5.80E-01	7.68E-01	0.011 (-0.036-0.057)	6.50E-01	8.81E-01	2.24 (-0.41-4.9)	1.01E-01	2.51E-01
TG(16:0_16:1_17:0)	-0.018 (-0.075-0.039)	5.37E-01	7.40E-01	0.005 (-0.039-0.049)	8.22E-01	9.30E-01	2.07 (-0.47-4.6)	1.14E-01	2.66E-01
TG(16:0_16:1_18:1)	0.000 (-0.050-0.049)	9.89E-01	9.96E-01	0.013 (-0.025-0.051)	4.96E-01	7.64E-01	0.81 (-1.44-3.07)	4.82E-01	5.86E-01
TG(16:0_17:0_18:0)	-0.008 (-0.067-0.052)	8.05E-01	8.97E-01	0.009 (-0.039-0.056)	7.22E-01	9.05E-01	2.46 (-0.22-5.14)	7.59E-02	2.16E-01
TG(16:0_17:0_18:1)	-0.009 (-0.064-0.047)	7.61E-01	8.95E-01	0.003 (-0.041-0.046)	9.03E-01	9.64E-01	2.18 (-0.38-4.74)	9.85E-02	2.50E-01
TG(16:0_17:0_18:2)	-0.004 (-0.060-0.052)	8.87E-01	9.35E-01	0.022 (-0.02-0.064)	3.00E-01	5.82E-01	2.7 (0.22-5.19)	**3.58E-02**	1.66E-01
TG(16:0_18:0_18:1)	-0.019 (-0.081-0.044)	5.60E-01	7.55E-01	0.012 (-0.042-0.065)	6.73E-01	8.83E-01	1.33 (-1.72-4.38)	3.95E-01	5.13E-01
TG(16:0_18:1_18:1)	0.007 (-0.035-0.049)	7.41E-01	8.85E-01	-0.002 (-0.036-0.032)	9.12E-01	9.64E-01	-0.03 (-2-1.93)	9.75E-01	9.87E-01
TG(16:0_18:1_18:2)	0.023 (-0.026-0.071)	3.65E-01	6.40E-01	0.001 (-0.036-0.038)	9.71E-01	9.95E-01	0.76 (-1.34-2.87)	4.79E-01	5.84E-01
TG(16:0_18:2_18:2)	0.028 (-0.038-0.094)	4.01E-01	6.61E-01	0.011 (-0.038-0.06)	6.72E-01	8.83E-01	2.16 (-0.38-4.69)	9.89E-02	2.50E-01
TG(16:1_16:1_16:1)	-0.003 (-0.045-0.038)	8.80E-01	9.35E-01	0.022 (-0.009-0.053)	1.75E-01	4.14E-01	1.81 (0-3.61)	5.32E-02	2.00E-01
TG(16:1_16:1_18:0)	-0.013 (-0.069-0.044)	6.59E-01	8.32E-01	-0.006 (-0.05-0.038)	7.93E-01	9.14E-01	1.54 (-0.95-4.03)	2.28E-01	3.62E-01
TG(16:1_16:1_18:1)	-0.003 (-0.051-0.044)	8.94E-01	9.35E-01	0.032 (-0.005-0.069)	9.57E-02	2.85E-01	1.44 (-0.73-3.62)	1.97E-01	3.54E-01

Lipid species [a]	Log-Norepinephrine			Non-esterified fatty acids			Heart Rate		
	β-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]	*β*-Coefficient (95%CI) [b]	*p*-value [c]	*corrected p*-value [d]
TG(16:1_17:0_18:1)	0.011 (-0.030-0.053)	5.97E-01	7.85E-01	0.004 (-0.028-0.035)	8.17E-01	9.30E-01	1.93 (0.07-3.79)	**4.49E-02**	1.83E-01
TG(16:1_18:1_18:1)	-0.008 (-0.057-0.041)	7.49E-01	8.85E-01	0.023 (-0.014-0.061)	2.19E-01	4.80E-01	1.74 (-0.54-4.03)	1.39E-01	2.96E-01
TG(16:1_18:1_18:2)	0.012 (-0.042-0.065)	6.73E-01	8.37E-01	0.015 (-0.025-0.055)	4.62E-01	7.34E-01	2.49 (0.23-4.75)	**3.33E-02**	1.61E-01
TG(17:0_18:1_18:1)	0.022 (-0.028-0.071)	3.96E-01	6.61E-01	-0.001 (-0.04-0.037)	9.51E-01	9.89E-01	1.67 (-0.53-3.87)	1.41E-01	2.99E-01
TG(18:0_18:0_18:0)	0.012 (-0.042-0.065)	6.66E-01	8.37E-01	0.009 (-0.032-0.051)	6.56E-01	8.81E-01	1.73 (-0.47-3.94)	1.27E-01	2.80E-01
TG(18:0_18:0_18:1)	-0.007 (-0.059-0.044)	7.84E-01	8.97E-01	-0.006 (-0.048-0.035)	7.63E-01	9.08E-01	1.31 (-1.05-3.67)	2.81E-01	4.02E-01
TG(18:0_18:1_18:1)	0.010 (-0.037-0.057)	6.75E-01	8.37E-01	0.004 (-0.033-0.041)	8.28E-01	9.30E-01	1.33 (-0.76-3.42)	2.16E-01	3.61E-01
TG(18:0_18:2_18:2)	0.022 (-0.034-0.079)	4.42E-01	6.77E-01	-0.007 (-0.049-0.035)	7.41E-01	9.07E-01	1.37 (-1-3.74)	2.60E-01	3.88E-01
TG(18:1_18:1_18:1)	0.020 (-0.033-0.073)	4.60E-01	6.90E-01	0.006 (-0.035-0.048)	7.63E-01	9.08E-01	1.29 (-1-3.59)	2.73E-01	4.02E-01
TG(18:1_18:1_18:2)	0.045 (-0.009-0.099)	1.03E-01	2.94E-01	0.007 (-0.034-0.048)	7.37E-01	9.05E-01	0.16 (-2.18-2.49)	8.96E-01	9.23E-01
TG(18:1_18:1_20:4)	0.033 (-0.016-0.081)	1.93E-01	4.25E-01	0.025 (-0.014-0.063)	2.09E-01	4.60E-01	1.2 (-0.98-3.37)	2.85E-01	4.02E-01
TG(18:1_18:1_22:6)	0.012 (-0.040-0.065)	6.45E-01	8.28E-01	-0.016 (-0.056-0.024)	4.24E-01	6.93E-01	1.06 (-1.22-3.35)	3.65E-01	4.87E-01
TG(18:1_18:2_18:2)	0.036 (-0.028-0.100)	2.70E-01	5.31E-01	-0.008 (-0.057-0.04)	7.33E-01	9.05E-01	2.1 (-0.63-4.83)	1.36E-01	2.94E-01
TG(18:2_18:2_18:2)	0.027 (-0.028-0.083)	3.38E-01	6.23E-01	-0.003 (-0.046-0.039)	8.76E-01	9.46E-01	1.65 (-0.74-4.04)	1.79E-01	3.30E-01
TG(18:2_18:2_20:4)	0.038 (-0.010-0.085)	1.22E-01	3.25E-01	0.022 (-0.014-0.059)	2.35E-01	5.06E-01	1.93 (-0.14-4.01)	7.11E-02	2.16E-01

[a] CE, cholesteryl ester; Cer(d18:0), dihydroceramide; Cer(d18:1), ceramide; COH, free cholesterol; DG, diacylglycerol; HexCer, monohexosylceramide; Hex2Cer, dihexosylceramide; Hex3Cer, trihexosylceramide; GM3, G_{M3} ganglioside; LPC, lysophosphatidylcholine; LPC(O), lysoalkylphosphatidylcholine; LPE, lysophosphatidylethanolamine; LPI, lysophosphatidylinositol; PC, phosphatidylcholine; PC(O), alkylphosphatidylcholine; PC(P), alkenylphosphatidylcholine; PE, phosphatidylethanolamine; PE(O), alkylphosphatidylethanolamine; PE(P), alkenylphosphatidylethanolamine; PG, phosphatidylglycerol; PI, phosphatidylinositol; SM, sphingomyelin; TG, triacylglycerol.

[b] *Beta coefficient (95% confidence intervals) based on an interquartile range increases in predictor lipid classes measurement, adjusting for age, sex, body mass index (BMI), systolic blood pressure (SBP) and Homeostatic model assessment-estimated insulin resistance (HOMA-IR).*

[c] *p-values not corrected for multiple comparisons.*

[d] *p-values corrected for multiple comparisons using the method of Benjamini Hochberg.*

Table 7: Partial and Part (Semi-partial) correlation analysis of plasma lipid classes/subclasses against log-norepinephrine in MetS

	Linear regression analysis			Pearson correlation coefficient	Partial correlation analysis			Part correlation analysis			
Lipid class	***β*-Coefficient [a]**	***p*-value [b]**	***corrected p*-value [c]**		**ρ_1 [d]**	***p*-value [b]**	***corrected p*-value [c]**	**ρ_2 [e]**	***p*-value [b]**	***corrected p*-value [c]**	**$(\rho_2)^2$ [f]**
Dihydroceramide	0.066	**0.009**	**0.035**	0.268	0.267	**0.009**	**0.035**	0.245	**0.022**	0.064	6.01%
Ceramide	0.079	**0.004**	**0.021**	0.297	0.318	**0.004**	**0.021**	0.292	**0.006**	**0.035**	8.54%
Monohexosylceramide	0.049	0.075	0.140	0.176	0.204	0.075	0.140	0.188	0.082	0.144	3.53%
Dihexosylceramide	0.063	**0.011**	**0.037**	0.248	0.306	**0.011**	**0.037**	0.282	**0.008**	**0.038**	7.93%
Trihexosylceramide	0.059	**0.036**	0.093	0.204	0.247	**0.036**	0.093	0.227	**0.035**	0.082	5.14%
GM3 ganglioside	0.025	0.351	0.475	0.106	0.118	0.351	0.475	0.108	0.319	0.386	1.17%
Sphingomyelin	0.070	**0.007**	**0.032**	0.282	0.274	**0.007**	**0.032**	0.252	**0.019**	0.061	6.35%
Phosphatidylcholine	0.063	**0.019**	0.056	0.258	0.298	**0.019**	0.056	0.274	**0.010**	**0.039**	7.50%
Alkylphosphatidylcholine	0.103	**0.000**	**0.005**	0.370	0.442	**0.000**	**0.005**	0.406	**0.000**	**0.002**	16.48%
Alkenylphosphatidylcholine	0.094	**0.002**	**0.018**	0.308	0.340	**0.002**	**0.018**	0.313	**0.003**	**0.024**	9.79%
Lysophosphatidylcholine	0.027	0.334	0.475	0.079	0.234	0.334	0.475	0.215	**0.046**	0.096	4.61%
Lysoalkylphosphatidylcholine	0.026	0.285	0.437	0.095	0.177	0.285	0.437	0.162	0.133	0.203	2.64%
Phosphatidylethanolamine	-0.014	0.611	0.703	-0.047	0.017	0.611	0.703	0.016	0.883	0.883	0.03%
Alkylphosphatidylethanolamine	0.043	0.079	0.140	0.182	0.245	0.079	0.140	0.225	**0.036**	0.082	5.08%
Alkenylphosphatidylethanolamine	0.049	0.077	0.140	0.185	0.227	0.077	0.140	0.209	0.052	0.100	4.37%
Lysophosphatidylethanolamine	0.019	0.494	0.597	0.081	0.188	0.494	0.597	0.173	0.109	0.179	3.00%
Phosphatidylinositol	0.031	0.246	0.404	0.139	0.152	0.246	0.404	0.140	0.197	0.267	1.95%
Lysophosphatidylinositol	0.058	0.060	0.137	0.233	0.171	0.060	0.137	0.157	0.147	0.211	2.46%
Phosphatidylglycerol	0.001	0.984	0.984	-0.002	0.056	0.984	0.984	0.051	0.638	0.667	0.26%
Free cholesterol	0.078	**0.002**	**0.018**	0.302	0.372	**0.002**	**0.018**	0.342	**0.001**	**0.014**	11.68%
Cholesteryl ester	0.021	0.454	0.579	0.054	0.126	0.454	0.579	0.115	0.287	0.367	1.33%
Diacylglycerol	0.010	0.742	0.812	-0.012	0.068	0.742	0.812	0.062	0.567	0.621	0.39%
Triacylglycerol	0.007	0.788	0.824	-0.006	0.085	0.788	0.824	0.078	0.472	0.542	0.61%

[a] Beta coefficient based on an interquartile range increases in predictor lipid classes measurement, adjusting for age, sex, body mass index (BMI), systolic blood pressure (SBP) and Homeostatic model assessment-estimated insulin resistance (HOMA-IR).

[b] p-values not corrected for multiple comparisons.

[c] p-values corrected for multiple comparisons using the method of Benjamini Hochberg.

[d] Partial correlation coefficient

[e] Part correlation coefficient

[f] Square of the part correlation coefficient

Table 8: Partial and Part (Semi-partial) correlation analysis of plasma lipid classes/subclasses against NEFA in MetS

Lipid class	Linear regression analysis			Pearson correlation coefficient	Partial correlation analysis			Part correlation analysis			
	β-Coefficient [a]	*p*-value [b]	*corrected p*-value [c]		ρ_1 [d]	*p*-value [b]	*corrected p*-value [c]	ρ_2 [e]	*p*-value [b]	*corrected p*-value [c]	$(\rho_2)^2$ [f]
Dihydroceramide	0.021	0.285	0.424	0.065	0.115	0.285	0.424	0.092	0.393	0.573	0.85%
Ceramide	0.030	0.154	0.253	0.086	0.153	0.154	0.253	0.123	0.255	0.419	1.50%
Monohexosylceramide	0.045	**0.024**	0.054	0.121	0.241	**0.024**	0.054	0.193	0.072	0.165	3.72%
Dihexosylceramide	0.054	**0.003**	**0.020**	0.252	0.311	**0.003**	**0.020**	0.249	**0.019**	0.120	6.21%
Trihexosylceramide	0.054	**0.013**	0.050	0.337	0.264	**0.013**	0.050	0.211	**0.049**	0.165	4.44%
GM3 ganglioside	0.069	**0.000**	**0.008**	0.300	0.374	**0.000**	**0.008**	0.299	**0.005**	0.107	8.95%
Sphingomyelin	0.048	**0.020**	0.054	0.354	0.248	**0.020**	0.054	0.198	0.064	0.165	3.94%
Phosphatidylcholine	0.061	**0.004**	**0.020**	0.260	0.308	**0.004**	**0.020**	0.246	**0.021**	0.120	6.05%
Alkylphosphatidylcholine	0.055	**0.010**	**0.044**	0.254	0.275	**0.010**	**0.044**	0.220	**0.039**	0.165	4.84%
Alkenylphosphatidylcholine	0.051	**0.022**	0.054	0.232	0.243	**0.022**	0.054	0.195	0.069	0.165	3.79%
Lysophosphatidylcholine	0.022	0.343	0.438	0.021	0.102	0.343	0.438	0.082	0.448	0.573	0.67%
Lysoalkylphosphatidylcholine	0.003	0.894	0.894	-0.003	0.014	0.894	0.894	0.012	0.915	0.915	0.01%
Phosphatidylethanolamine	0.022	0.319	0.431	0.074	0.107	0.319	0.431	0.086	0.426	0.573	0.74%
Alkylphosphatidylethanolamine	-0.006	0.740	0.809	-0.017	-0.036	0.740	0.809	-0.029	0.791	0.855	0.08%
Alkenylphosphatidylethanolamine	0.010	0.637	0.733	0.015	0.051	0.637	0.733	0.041	0.706	0.812	0.17%
Lysophosphatidylethanolamine	0.034	0.119	0.228	0.151	0.167	0.119	0.228	0.134	0.214	0.410	1.79%
Phosphatidylinositol	0.061	**0.003**	**0.020**	0.326	0.315	**0.003**	**0.020**	0.252	**0.018**	0.120	6.34%
Lysophosphatidylinositol	0.050	**0.034**	0.070	0.310	0.227	**0.034**	0.070	0.181	0.091	0.190	3.29%
Phosphatidylglycerol	0.013	0.526	0.637	-0.014	0.068	0.526	0.637	0.055	0.612	0.741	0.30%
Free cholesterol	0.047	**0.021**	0.054	0.231	0.247	**0.021**	0.054	0.197	0.065	0.165	3.89%
Cholesteryl ester	0.033	0.151	0.253	0.048	0.154	0.151	0.253	0.123	0.252	0.419	1.52%
Diacylglycerol	0.024	0.295	0.424	-0.084	0.113	0.295	0.424	0.090	0.403	0.573	0.82%
Triacylglycerol	0.006	0.774	0.809	-0.108	0.031	0.774	0.809	0.025	0.818	0.855	0.06%

[a] *Beta coefficient based on an interquartile range increases in predictor lipid classes measurement, adjusting for age, sex, body mass index (BMI), systolic blood pressure (SBP) and Homeostatic model assessment-estimated insulin resistance (HOMA-IR).*

[b] *p-values not corrected for multiple comparisons.*

[c] *p-values corrected for multiple comparisons using the method of Benjamini Hochberg.*

[d] *Partial correlation coefficient*

[e] *Part correlation coefficient*

[f] *Square of the part correlation coefficient*

Table 9: Partial and Part (Semi-partial) correlation analysis of plasma lipid classes/subclasses against heart rate in MetS

Lipid class	Linear regression analysis			Pearson correlation coefficient	Partial correlation analysis			Part correlation analysis			
	β-Coefficient [a]	*p*-value [b]	*corrected p*-value [c]		ρ_1 [d]	*p*-value [b]	*corrected p*-value [c]	ρ_2 [e]	*p*-value [b]	*corrected p*-value [c]	$(\rho_2)^2$ [f]
Dihydroceramide	2.320	**0.038**	0.107	0.238	0.222	**0.038**	0.107	0.211	0.050	0.137	4.43%
Ceramide	2.650	**0.023**	0.104	0.268	0.244	**0.023**	0.104	0.231	**0.031**	0.137	5.33%
Monohexosylceramide	2.090	0.068	0.130	0.173	0.197	0.068	0.130	0.186	0.084	0.161	3.47%
Dihexosylceramide	2.090	**0.046**	0.107	0.207	0.214	**0.046**	0.107	0.203	0.060	0.137	4.11%
Trihexosylceramide	0.380	0.761	0.795	0.027	0.033	0.761	0.795	0.031	0.773	0.808	0.10%
GM3 ganglioside	2.850	**0.011**	0.063	0.260	0.271	**0.011**	0.063	0.257	**0.016**	0.094	6.60%
Sphingomyelin	3.130	**0.007**	0.063	0.284	0.289	**0.007**	0.063	0.273	**0.010**	0.094	7.46%
Phosphatidylcholine	2.280	0.056	0.118	0.243	0.205	0.056	0.118	0.194	0.071	0.149	3.77%
Alkylphosphatidylcholine	2.070	0.089	0.157	0.186	0.183	0.089	0.157	0.174	0.108	0.191	3.01%
Alkenylphosphatidylcholine	1.510	0.241	0.292	0.132	0.127	0.241	0.292	0.120	0.267	0.324	1.45%
Lysophosphatidylcholine	2.670	**0.039**	0.107	0.157	0.222	**0.039**	0.107	0.210	0.051	0.137	4.42%
Lysoalkylphosphatidylcholine	1.470	0.174	0.226	0.106	0.147	0.174	0.226	0.139	0.199	0.257	1.93%
Phosphatidylethanolamine	0.310	0.806	0.806	0.066	0.027	0.806	0.806	0.025	0.816	0.816	0.06%
Alkylphosphatidylethanolamine	1.630	0.133	0.193	0.171	0.162	0.133	0.193	0.154	0.156	0.226	2.36%
Alkenylphosphatidylethanolamine	2.420	**0.044**	0.107	0.242	0.217	**0.044**	0.107	0.205	0.057	0.137	4.20%
Lysophosphatidylethanolamine	1.640	0.177	0.226	0.119	0.146	0.177	0.226	0.138	0.201	0.257	1.91%
Phosphatidylinositol	3.070	**0.009**	0.063	0.305	0.280	**0.009**	0.063	0.265	**0.013**	0.094	7.02%
Lysophosphatidylinositol	3.500	**0.010**	0.063	0.286	0.274	**0.010**	0.063	0.260	**0.015**	0.094	6.74%
Phosphatidylglycerol	0.470	0.656	0.719	0.073	0.048	0.656	0.719	0.046	0.674	0.738	0.21%
Free cholesterol	2.360	**0.040**	0.107	0.244	0.220	**0.040**	0.107	0.208	0.053	0.137	4.35%
Cholesteryl ester	2.110	0.119	0.193	0.218	0.168	0.119	0.193	0.159	0.140	0.226	2.54%
Diacylglycerol	1.890	0.135	0.193	0.163	0.162	0.135	0.193	0.153	0.157	0.226	2.34%
Triacylglycerol	1.170	0.271	0.311	0.148	0.119	0.271	0.311	0.113	0.298	0.342	1.28%

[a] *Beta coefficient based on an interquartile range increases in predictor lipid classes measurement, adjusting for age, sex, body mass index (BMI), systolic blood pressure (SBP) and Homeostatic model assessment-estimated insulin resistance (HOMA-IR).*

[b] *p-values not corrected for multiple comparisons.*

[c] *p-values corrected for multiple comparisons using the method of Benjamini Hochberg.*

[d] *Partial correlation coefficient*

[e] *Part correlation coefficient*

[f] *Square of the part correlation coefficient*