Regional diffusion imaging changes related to obesity after adjusting for other risk factors: the UK Biobank study

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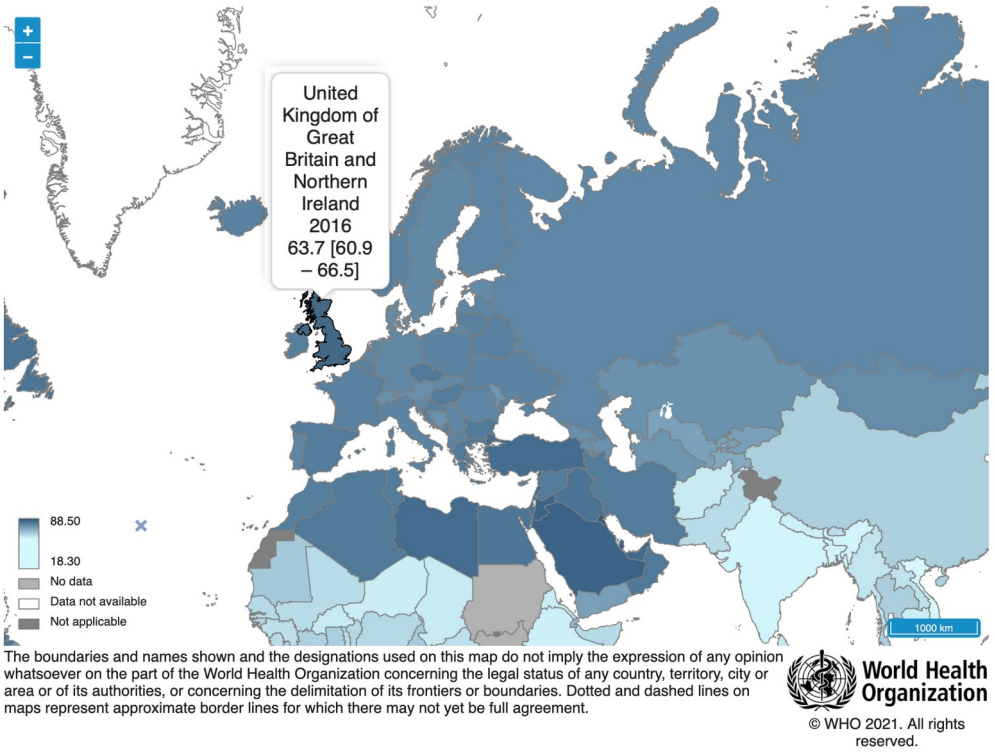
Disclosures

Dr Karolina Wartolowska
has no conflicts of interest to disclose.

Background



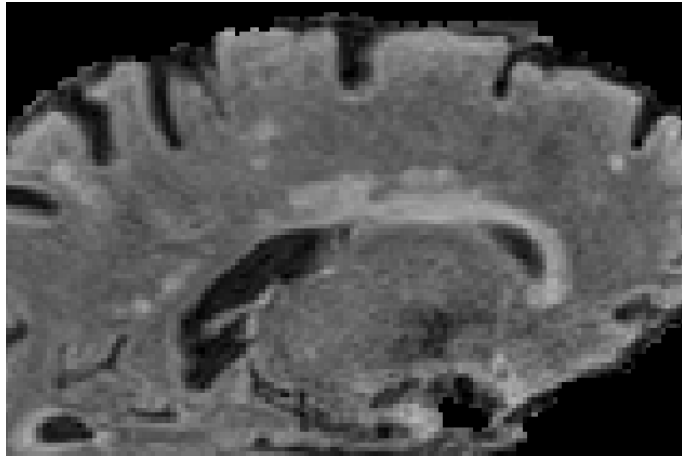
Cerebral small vessel disease

is a common cause of white matter damage in older people. It is strongly associated with age, hypertension, smoking, diabetes, and obesity.

In the UK, **27% of adults are obese**

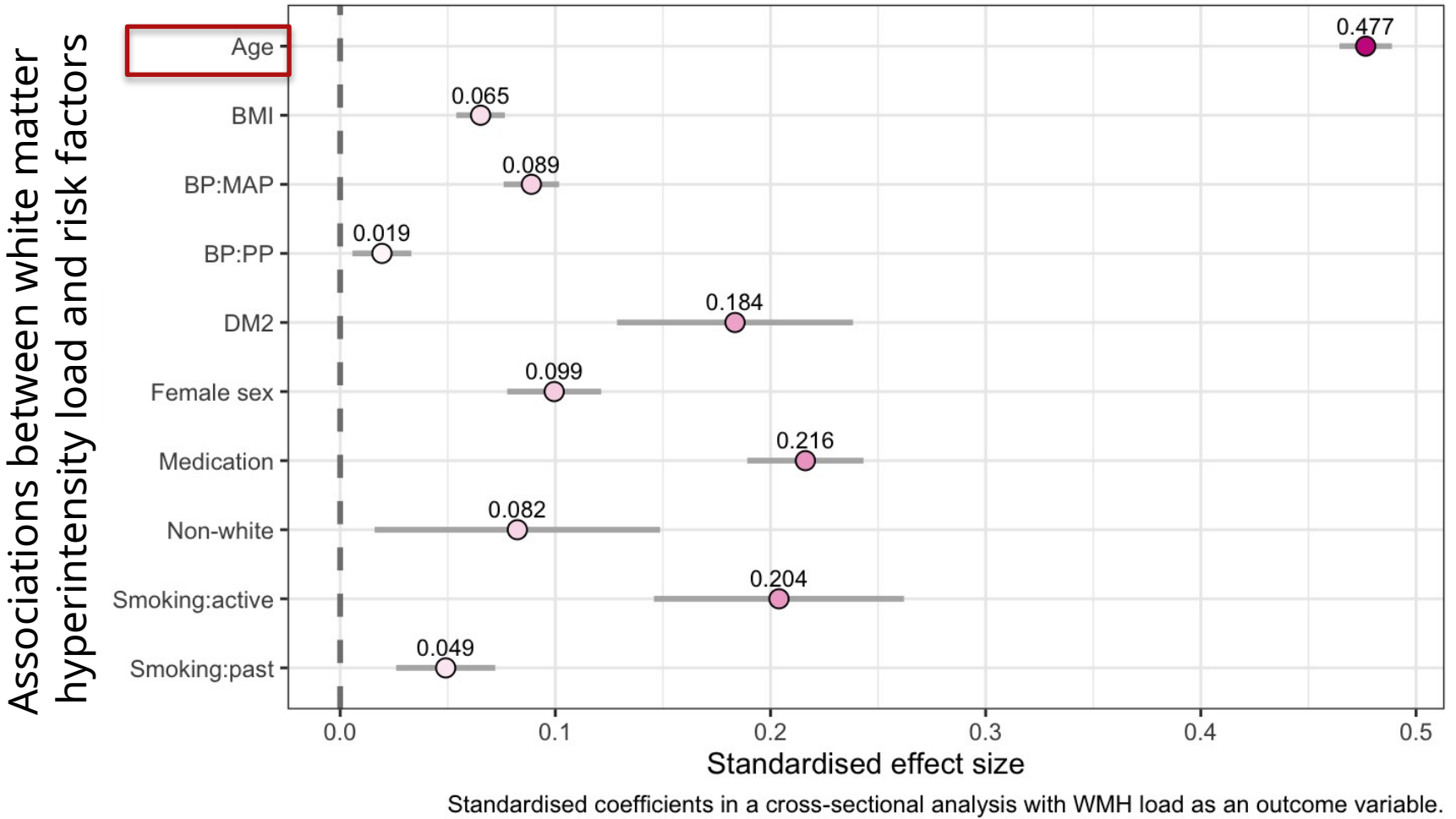
and 64% are overweight.

Background



Cerebral small vessel disease damages small vessels and surrounding brain tissue.

White matter injury is evident on structural MRI as white matter hyperintensities, but the disease also affects white matter that appears normal, and these microstructural changes can be quantified using diffusion imaging (dMRI).


Associations between white matter hyperintensity load and risk factors
Age
BMI
BP:MAP
BP:PP
DM2
Female sex
Medication
Non-white
Smoking:active
Smoking:past
0.477
0.065
0.089
0.019
0.184
0.099
0.216
0.082
0.204
0.049
0.0
0.1
0.2
0.3
0.4
0.5
Standardised effect size
Standardised coefficients in a cross-sectional analysis with WMH load as an outcome variable.

Aims

The aim of this study was to investigate the effect of being overweight, as estimated using the body mass index (**BMI**),

on microstructural white matter damage assessed using **dMRI**

and the interactions between the BMI and blood pressure.

Methods

Data: UK Biobank is a prospective cohort of 502,413 community-based people, 37-73 years old at recruitment; brain MRI data available for 45,877.

dMRI measures, both DTI and NODDI: fractional anisotropy (FA)

mean diffusivity (MD)

intracellular volume fraction (ICVF)

isotropic volume fraction (ISOVF)

orientation dispersion (OD)

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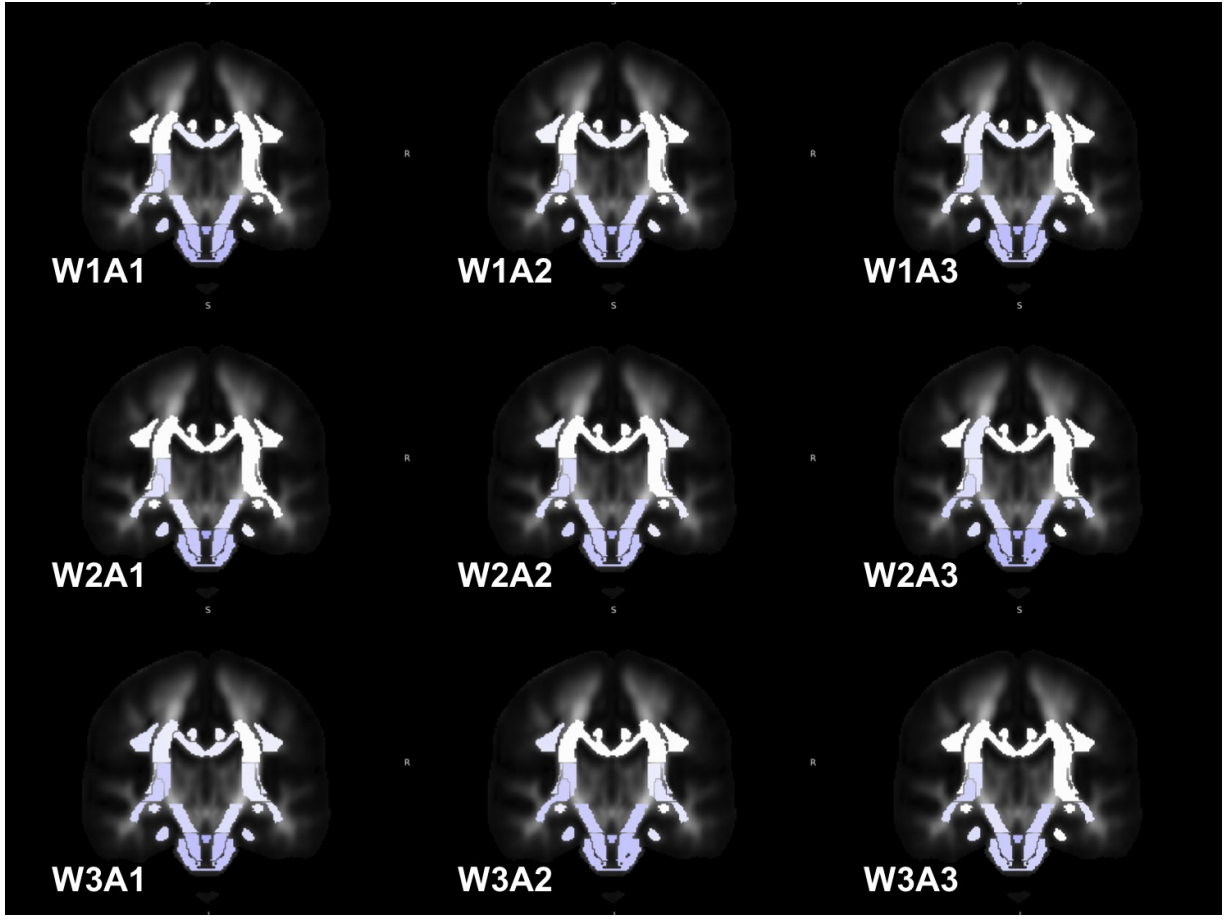
Methods

All predictors were standardised before modelling.

The associations between dMRI within each of the 27 white matter tracts were analysed using mixed-effects models with fixed effects for BMI, age, sex, mean arterial blood pressure, pulse pressure, source of blood pressure measurement, smoking, diabetes, antihypertensive medication, and location of the tract within the cerebral circulation; and with random intercepts for the white matter tract and participant.

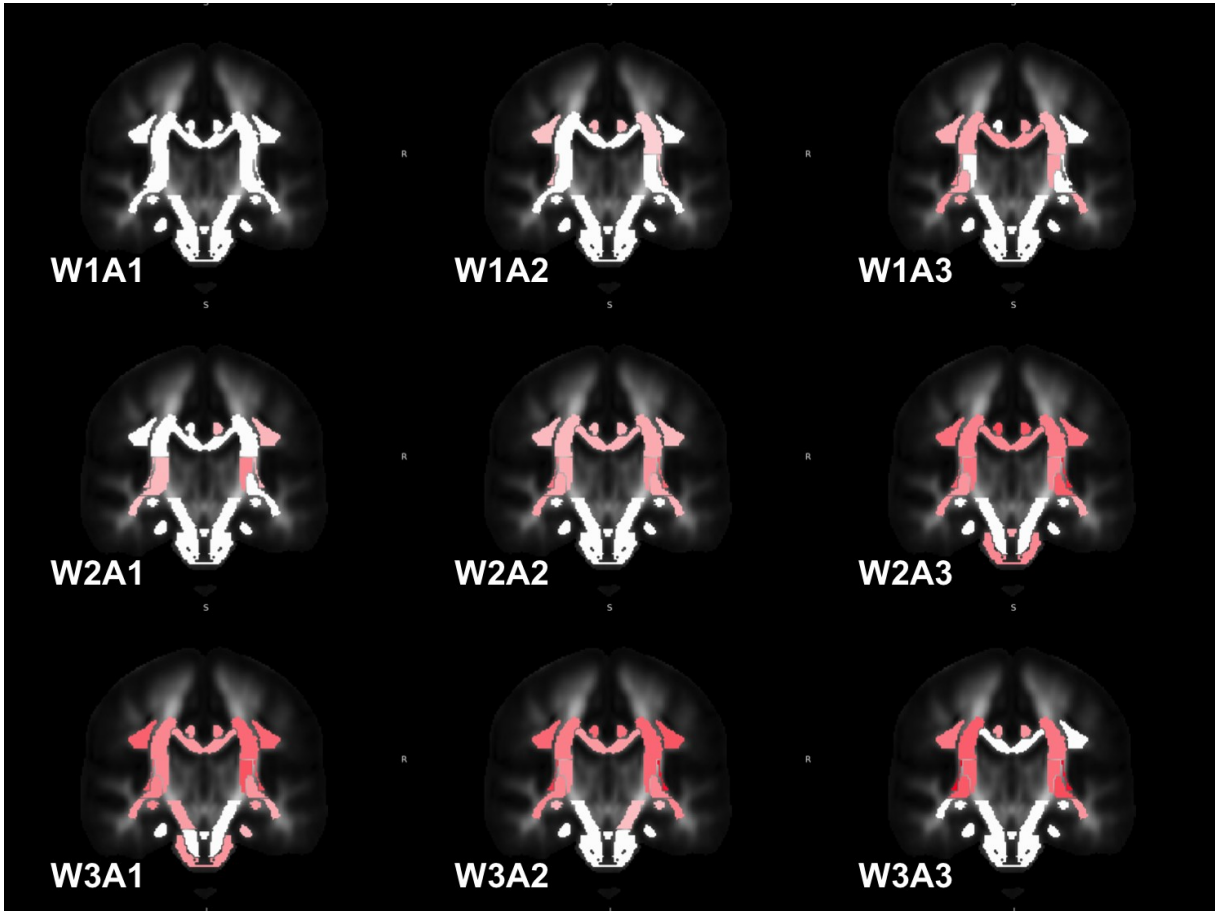
Results



Associations between mean diffusivity (MD) and BMI in each white matter tract, in a fully-adjusted model.

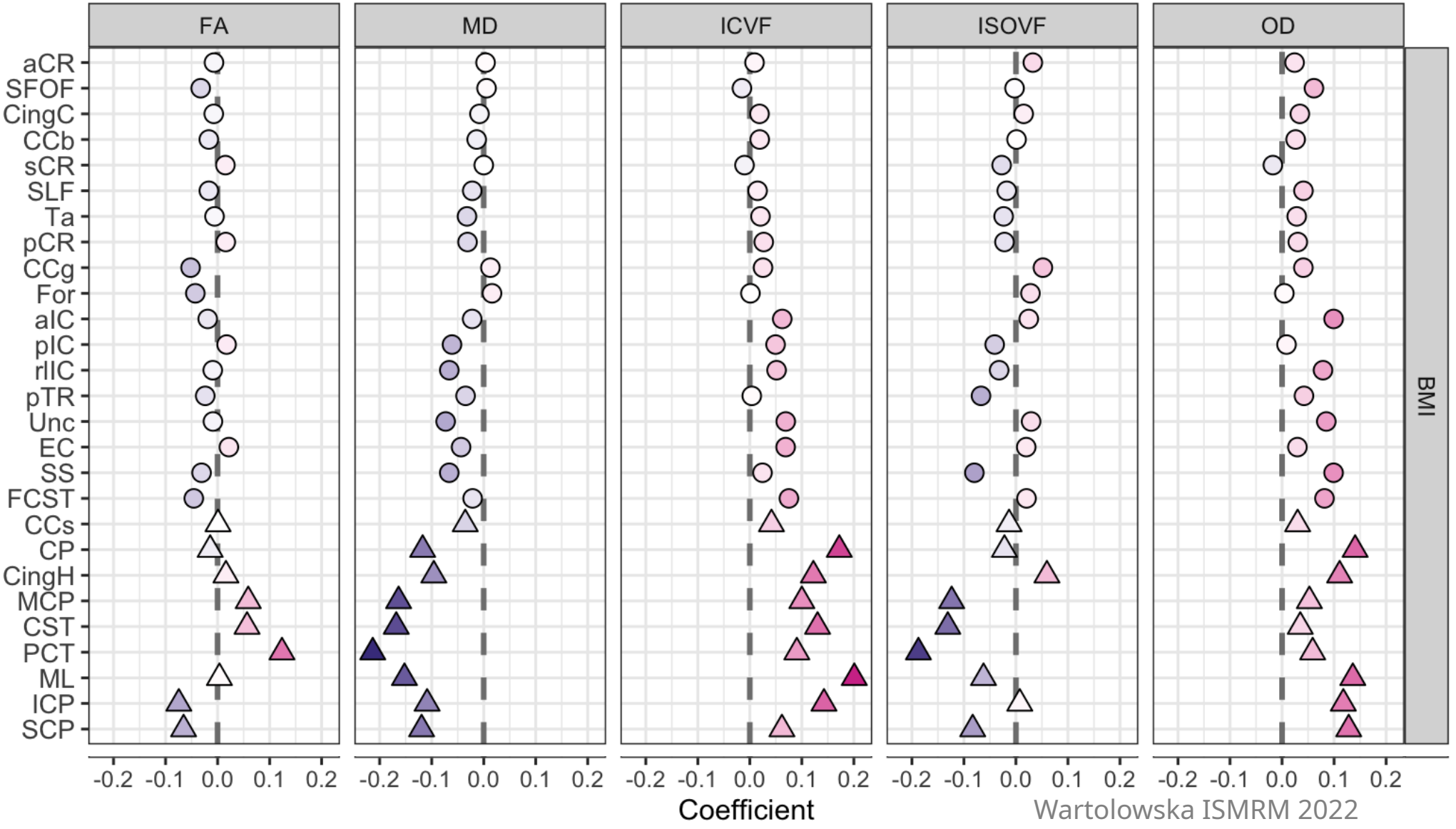
Stratified by tertials of age (A1 to A3) in each column and tertials of white matter hyperintensity (W1-W3) in each row.

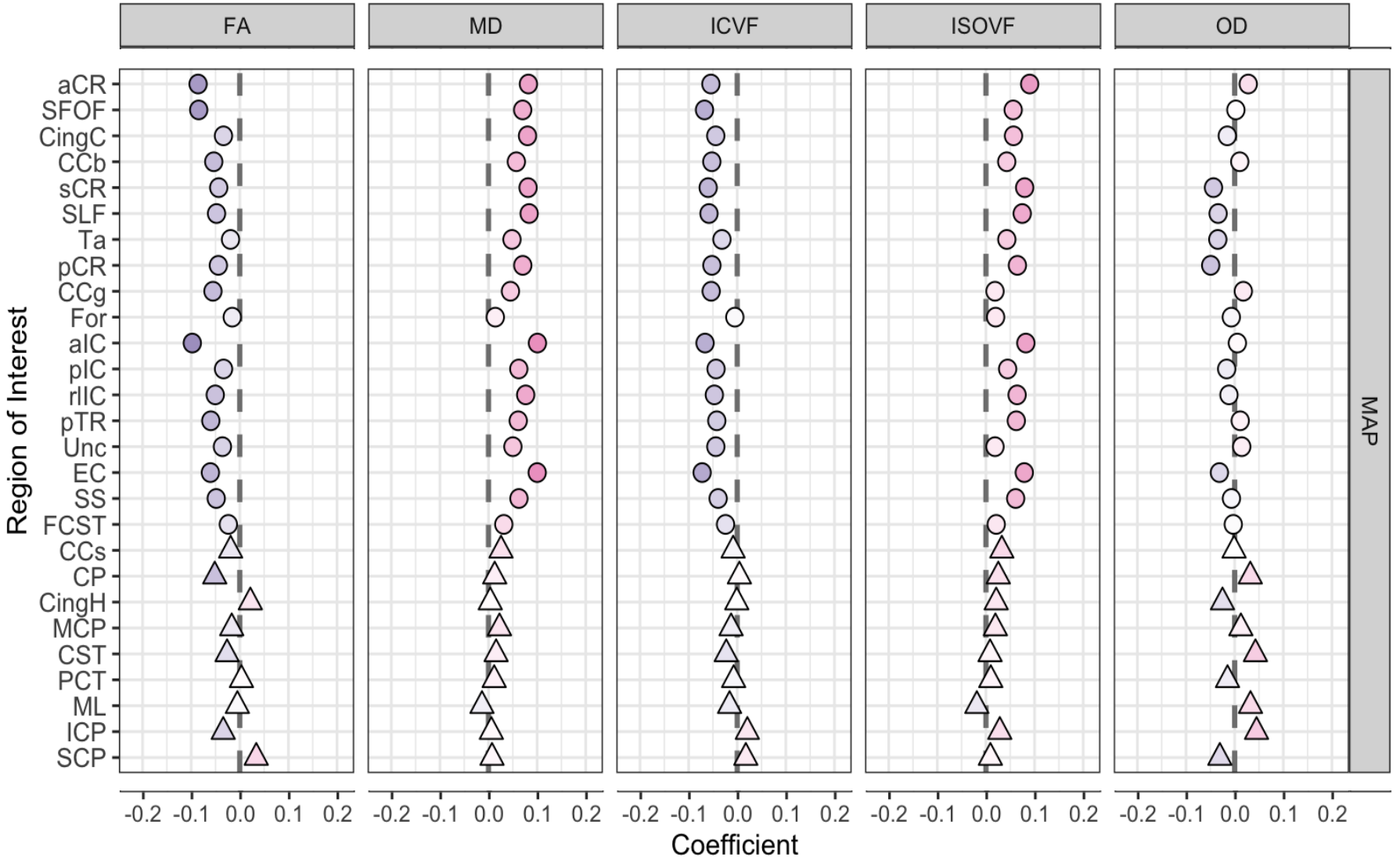
Results



Associations between mean diffusivity (MD) and PP in each white matter tract, in a fully-adjusted model.

Stratified by tertials of age (A1 to A3) in each column and tertials of white matter hyperintensity (W1-W3) in each row.


FA
MD
ICVF
ISOVF
OD
BMI
aCR
SFOF
CingC
CCb
sCR
SLF
Ta
pCR
CCg
For
aIC
pIC
rlIC
pTR
Unc
EC
SS
FCST
CCs
CP
CingH
MCP
CST
PCT
ML
ICP
SCP
-0.2
-0.1
0.0
0.1
0.2
Coefficient



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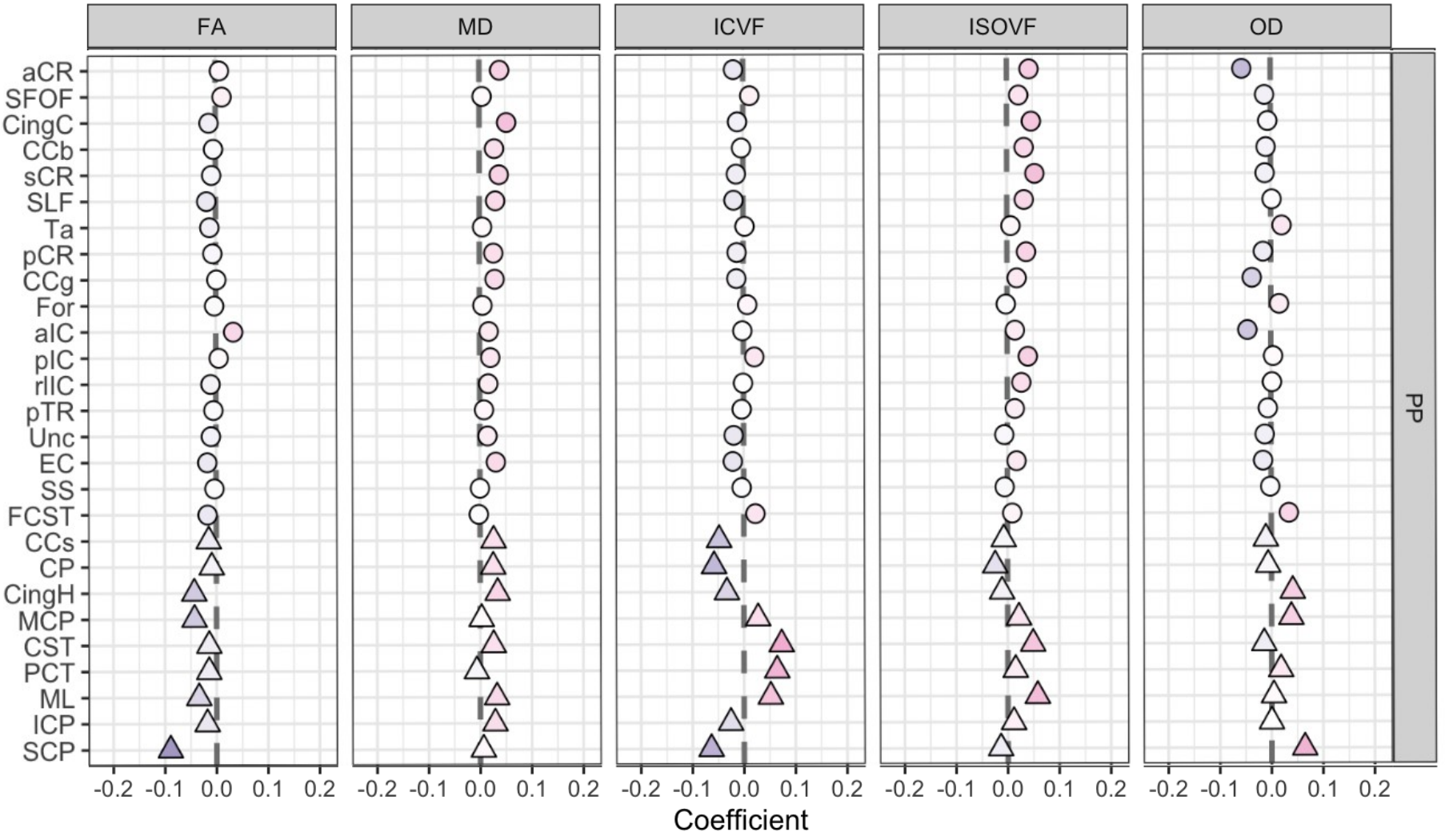

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Results

Variable	FA Estimate (95%CIs)	MD Estimate (95%CIs)	ICVF Estimate (95%CIs)	ISOVF Estimate (95%CIs)	OD Estimate (95%CIs)
Age	-0.209 (-0.218 to -0.200)	0.225 (0.216 to 0.234)	-0.168 (-0.178 to -0.157)	0.180 (0.173 to 0.188)	0.064 (0.057 to 0.071)
Female	-0.107 (-0.122 to -0.091)	-0.016 (-0.032 to 0.000)	-0.056 (-0.074 to -0.038)	-0.028 (-0.040 to -0.015)	0.107 (0.095 to 0.119)
BMI	-0.019 (-0.027 to -0.010)	-0.019 (-0.027 to -0.011)	0.024 (0.014 to 0.033)	-0.001 (-0.008 to 0.006)	0.043 (0.037 to 0.050)
MAP	-0.073 (-0.085 to -0.062)	0.083 (0.072 to 0.094)	-0.073 (-0.086 to -0.060)	0.058 (0.049 to 0.067)	-0.002 (-0.011 to 0.006)
PP	-0.009 (-0.021 to 0.003)	0.033 (0.021 to 0.044)	-0.012 (-0.026 to 0.002)	0.031 (0.022 to 0.041)	-0.011 (-0.020 to -0.002)
antiHT	-0.152 (-0.172 to -0.131)	0.151 (0.131 to 0.171)	-0.094 (-0.118 to -0.070)	0.144 (0.128 to 0.160)	0.049 (0.033 to 0.065)
circPosterior:PP	0.019 (0.014 to 0.024)	-0.115 (-0.120 to -0.110)	0.101 (0.096 to 0.105)	-0.072 (-0.077 to -0.066)	0.056 (0.050 to 0.061)
circPosterior:MAP	0.058 (0.053 to 0.062)	-0.057 (-0.062 to -0.052)	0.063 (0.059 to 0.067)	-0.034 (-0.039 to -0.029)	0.006 (0.001 to 0.012)
circPosterior:BMI	0.034 (0.030 to 0.038)	-0.118 (-0.122 to -0.114)	0.100 (0.096 to 0.104)	-0.064 (-0.069 to -0.060)	0.047 (0.042 to 0.051)
BMI:PP	0.009 (0.000 to 0.017)	-0.005 (-0.013 to 0.004)	-0.004 (-0.014 to 0.006)	-0.010 (-0.017 to -0.003)	-0.013 (-0.019 to -0.006)
BMI:MAP	-0.009 (-0.017 to 0.000)	0.009 (0.001 to 0.018)	0.004 (-0.006 to 0.014)	0.016 (0.009 to 0.023)	0.007 (0.000 to 0.013)

Conclusions

Obesity is an independent risk factor for white matter damage.

The effect of obesity is stronger in the posterior circulation.

The relationships between obesity, blood pressure,
and microstructural white matter injury are complex.


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