Supplementary Material

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Gluten intake and metabolic health: conflicting findings from the UK Biobank

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Supplemental Figure legends

Online Resource 1
Venn diagram depicting number of participants excluded by six exclusion criteria

Online Resource 2
Boxplots depicting **a** gluten intake and **b** energy-adjusted gluten intake depending on sex

Online Resource 3
Predictor effects plots of multiple linear regression analysis determining association of percentage body fat (dependent variable) with **a** energy-adjusted gluten intake, **b** sex, **c** age, **d** smoking status, **e** qualifications, **f** ethnic background, **g** income, and **h** MET per week (independent variables)

Online Resource 4
Predictor effects plots of multiple linear regression analysis determining association of percentage body fat (dependent variable) with **a**, **b** gluten intake adjusted as summarized in Fig. 1 or **c**, **d** energy-adjusted gluten intake adjusted as summarized in Online Resource 3 (independent variables) depending on sex. Models in **a**, **c** are further adjusted for markers of diet quality, i.e. consumption of cooked vegetables, salad, fresh fruit, oily fish, processed meat, added salt, saturated fat, polyunsaturated fat, and fiber. Models in **b**, **d** include participants with implausible energy intake
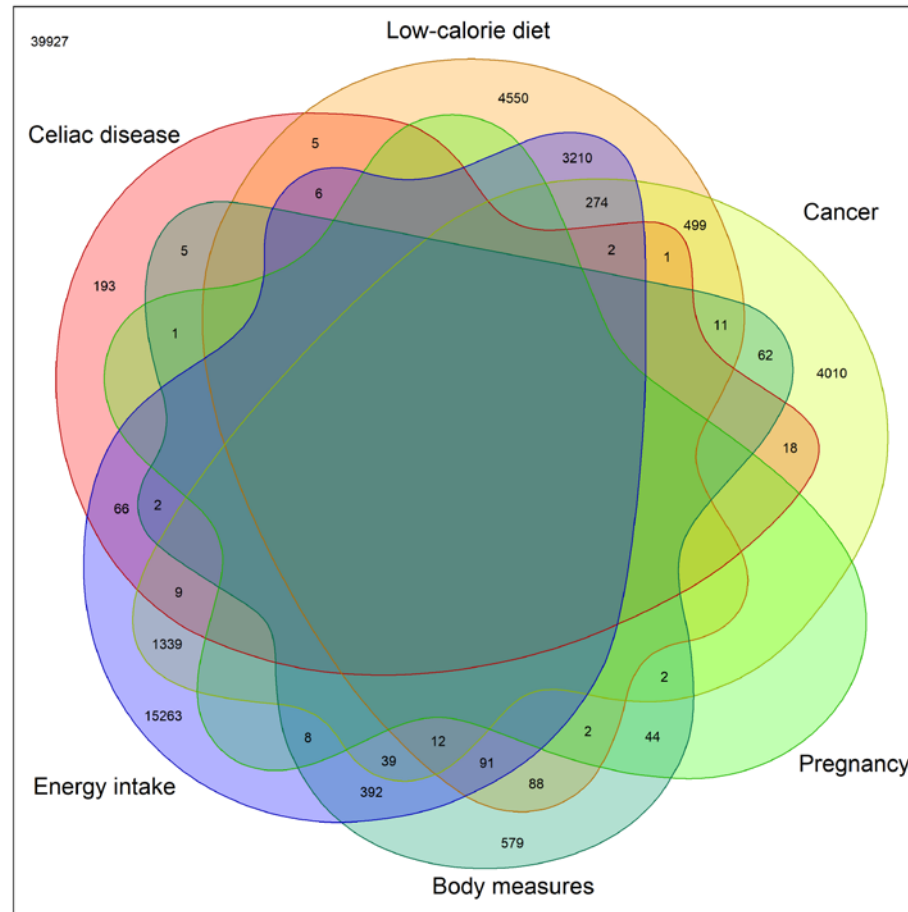
Online Resource 5
Predictor effects plots of multiple linear regression analysis determining association of percentage body fat (dependent variable) with **a-c** gluten intake adjusted as summarized in Fig. 1 or **d-f** energy-adjusted gluten intake adjusted as summarized in Online Resource 3 (independent variables) depending on sex. Participants with **a**, **d** diabetes mellitus (i.e. at least one of the following criteria: established diagnosis of diabetes mellitus, diabetes medication, HbA1c ≥ 48 mmol/mol Hb, non-fasting glucose ≥ 11.1 mmol/l), **b**, **e** arterial hypertension (i.e. at least one of the following criteria: blood pressure medication, SBP > 140 mmHg, DBP > 90 mmHg), or **c**, **f** dyslipidemia (i.e. at least one of the following criteria: cholesterol medication, HDL cholesterol ≤ 1.03 mmol/l for male or ≤1.29 mmol/l for female) are excluded from the analysis

Online Resource 6
Predictor effects plots of multiple linear regression analysis determining association of further markers of obesity (dependent variables), i.e. **a** WC, **b** WHR, **c** WHtR, and **d** BMI with gluten intake (independent variable) in models adjusted as summarized in Table 2
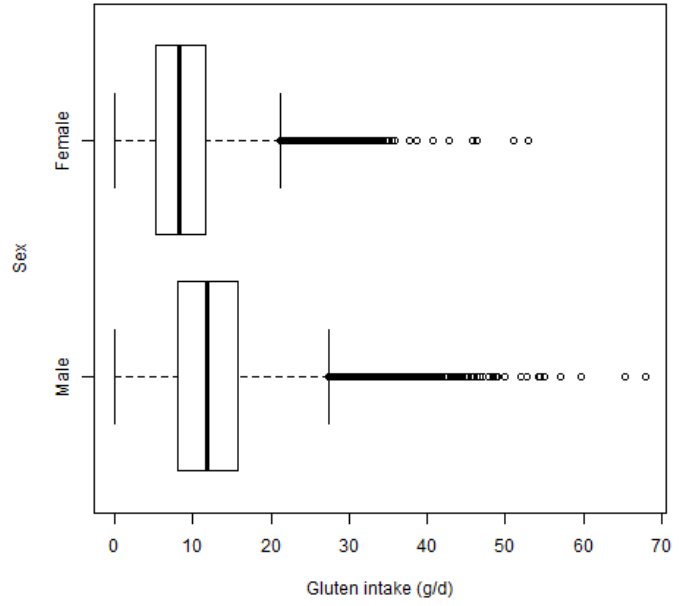
Online Resource 7
Predictor effects plots of multiple linear regression analysis determining association of markers of metabolic health (dependent variables), i.e. **a** SBP, **b** DBP, **c** HbA1c, **d** CRP, and **e** GFR with gluten intake (independent variable) in models adjusted as summarized in Table 2
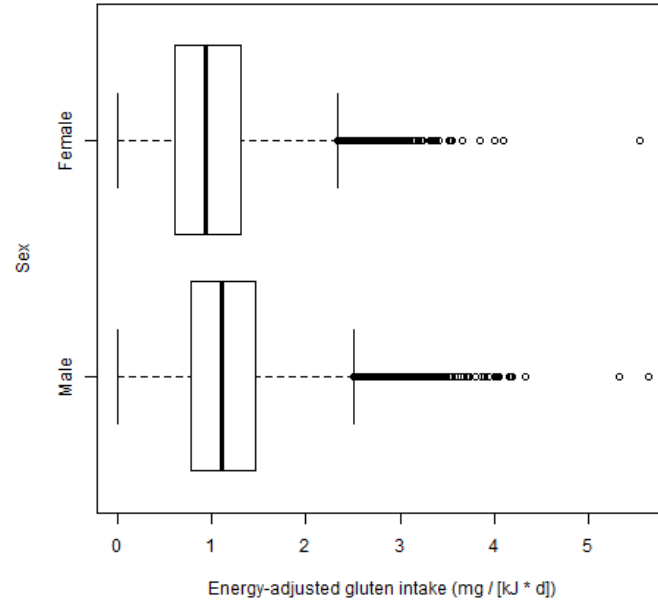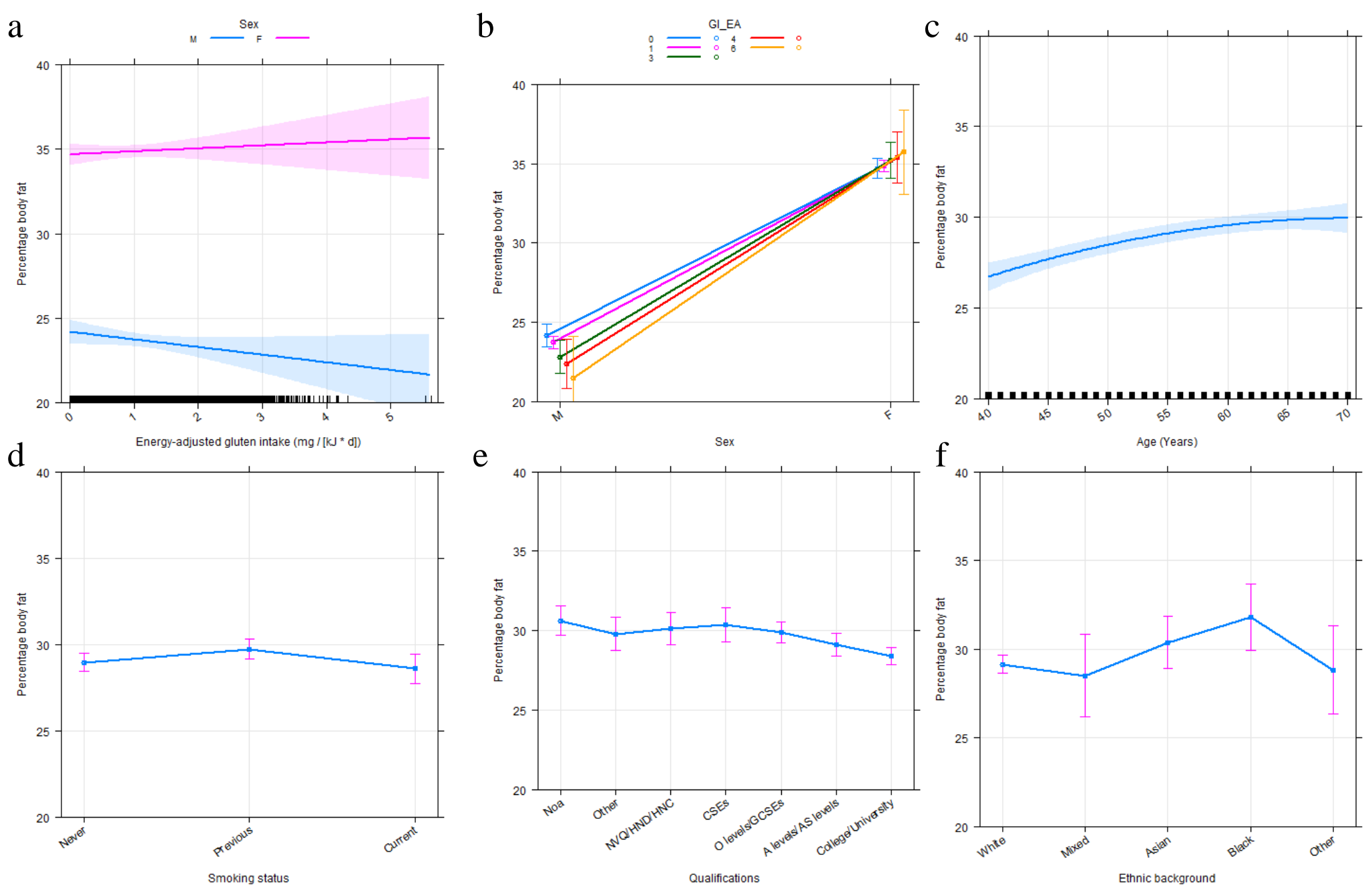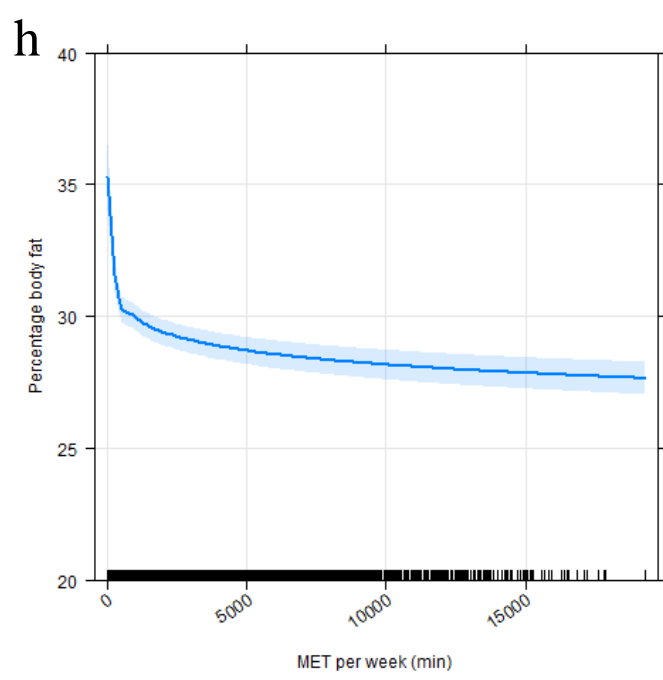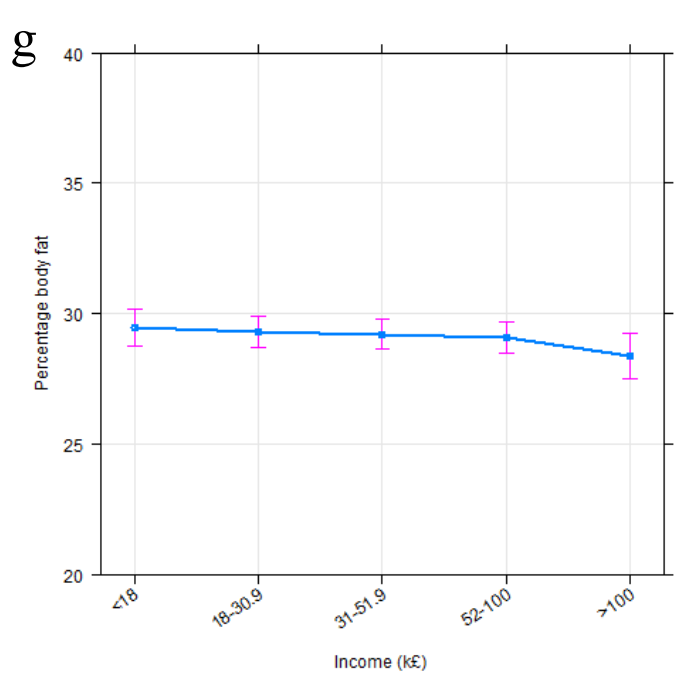
Online Resource 1

a

b

Online Resource 2

Online Resource 3

g — Percentage body fat vs Income (k£)

h — Percentage body fat vs MET per week (min)

Online Resource 3

Adjustment for markers of diet quality
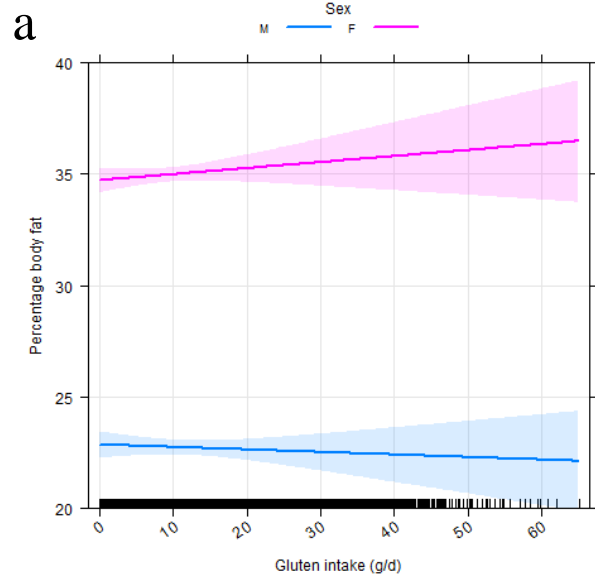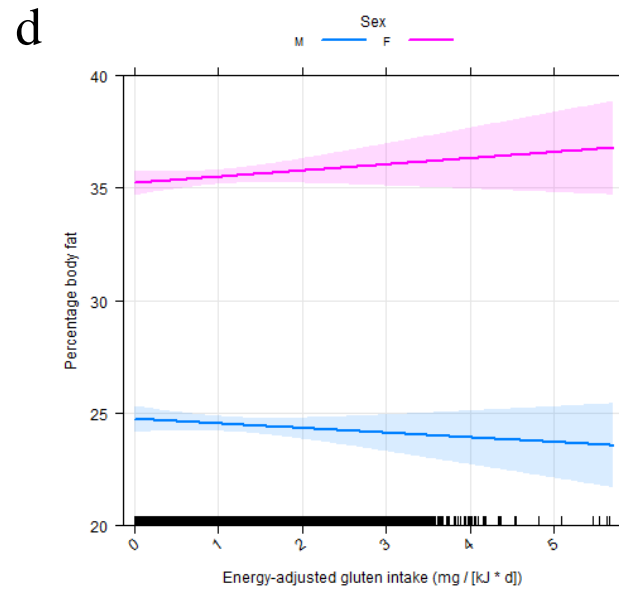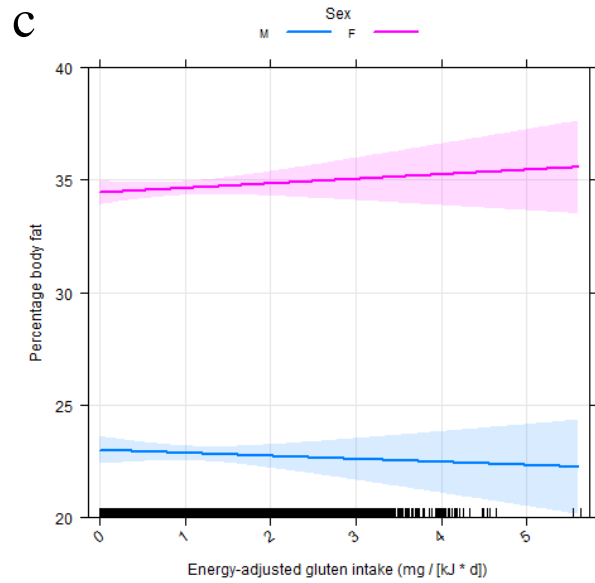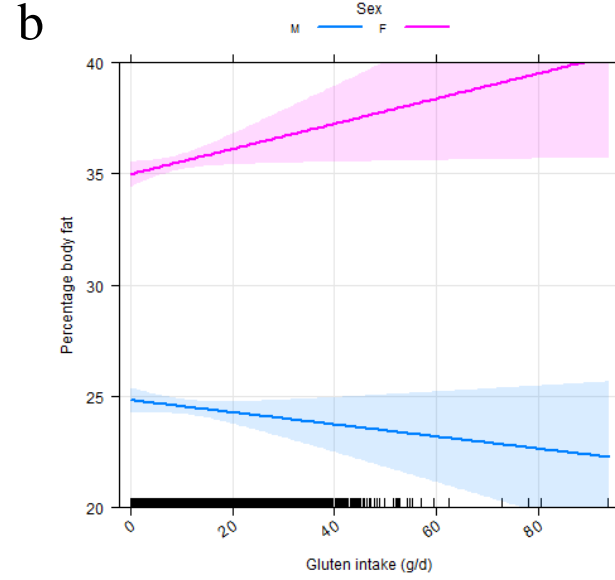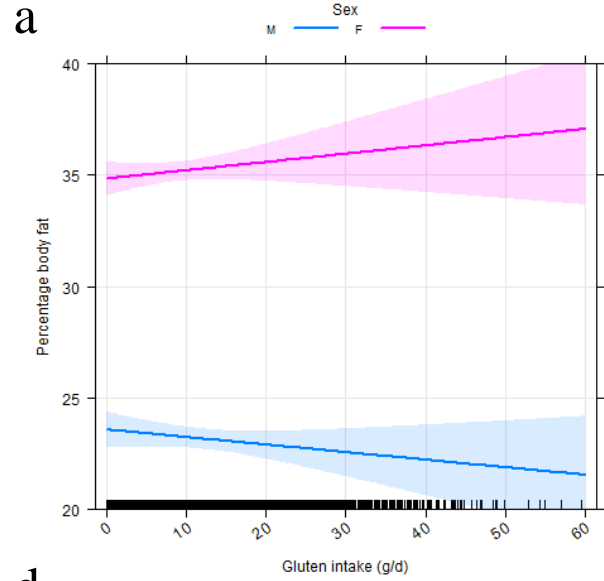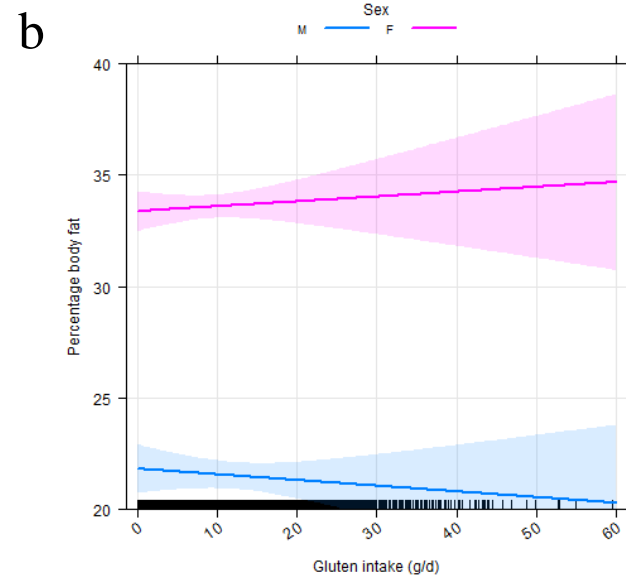
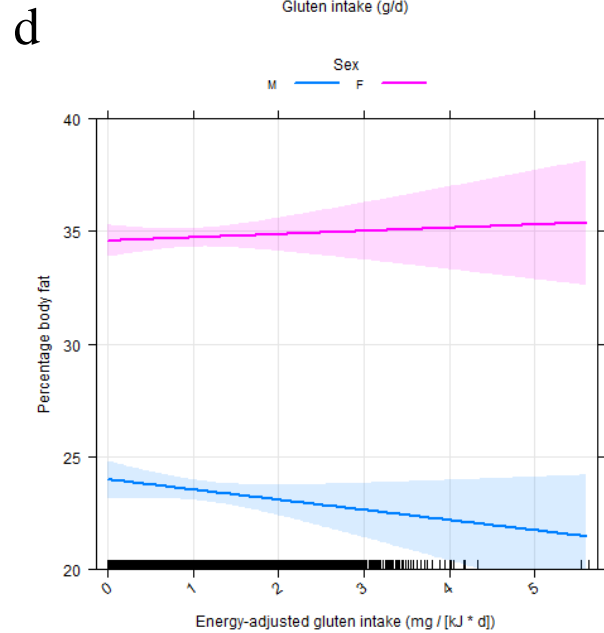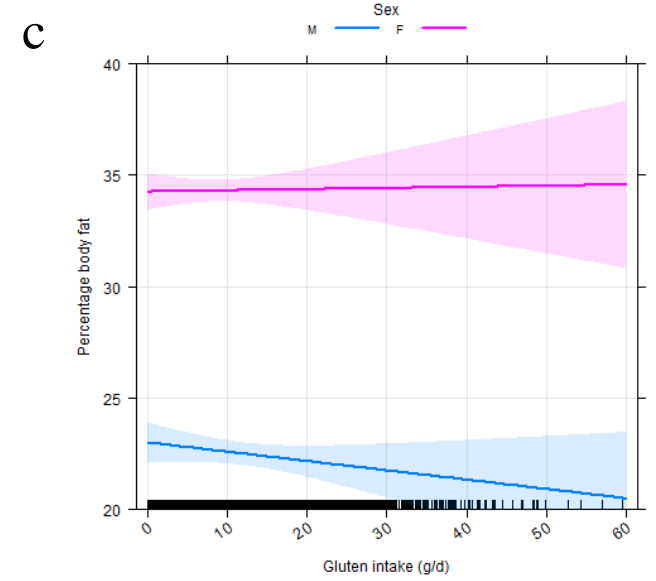**Inclusion of participants with implausible energy intake**

Online Resource 4

Online Resource 5

Online Resource 6
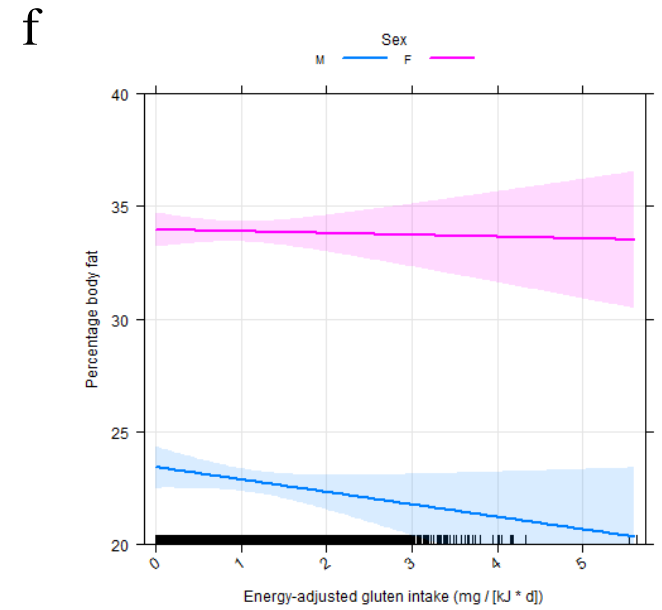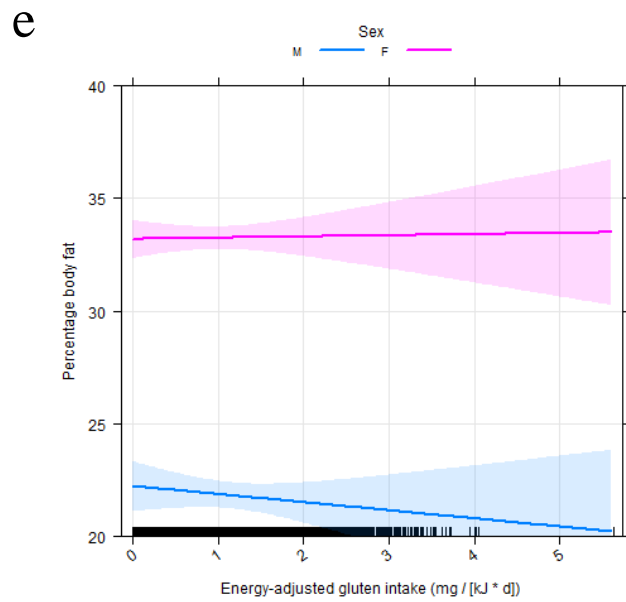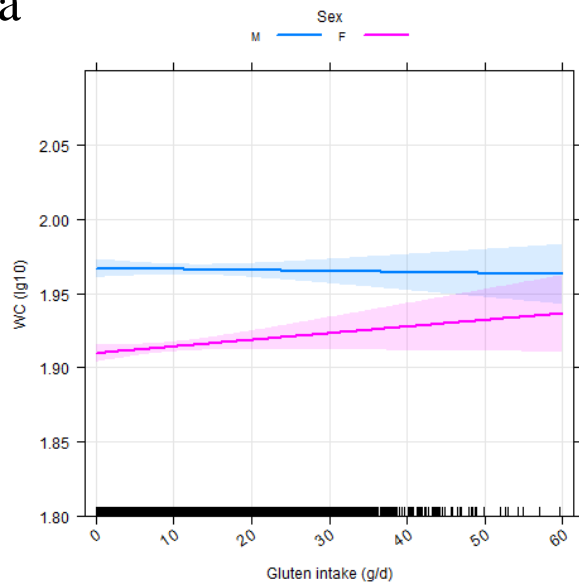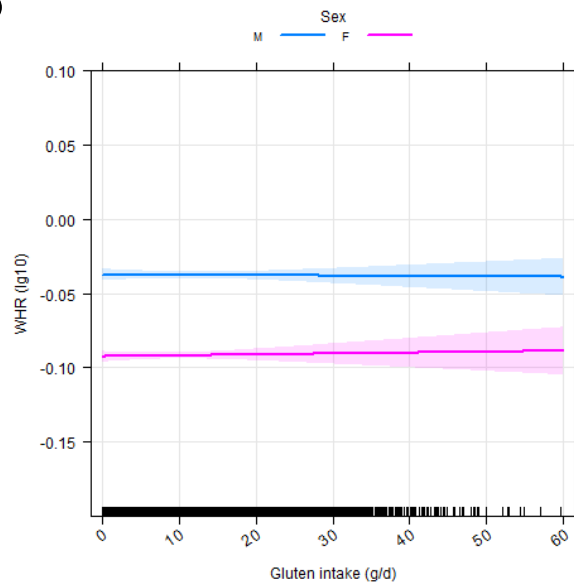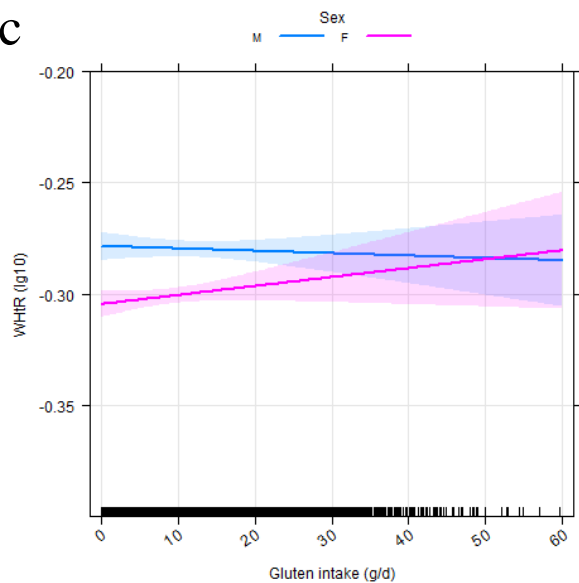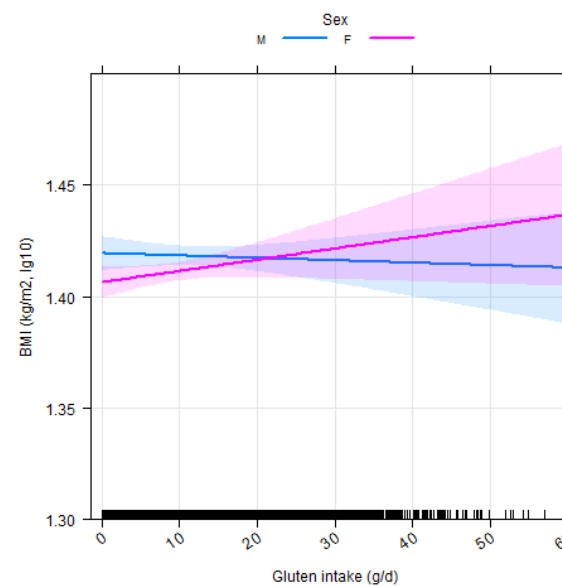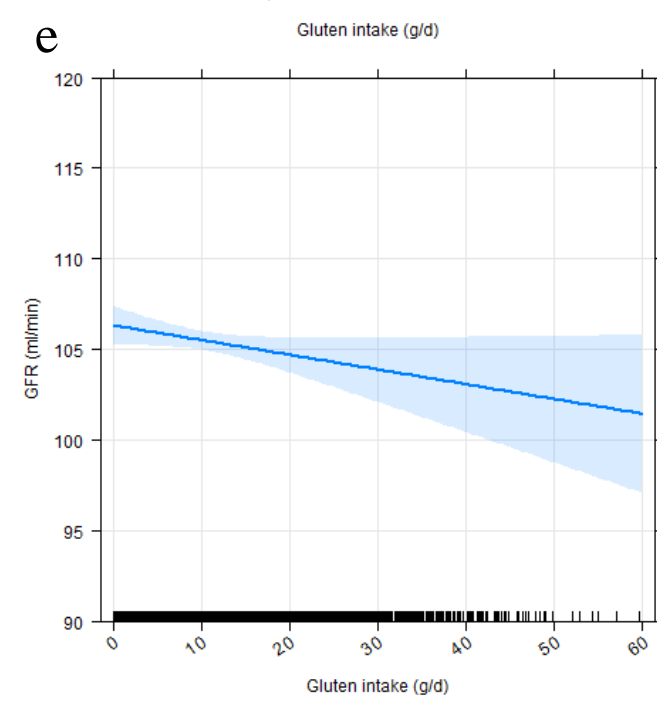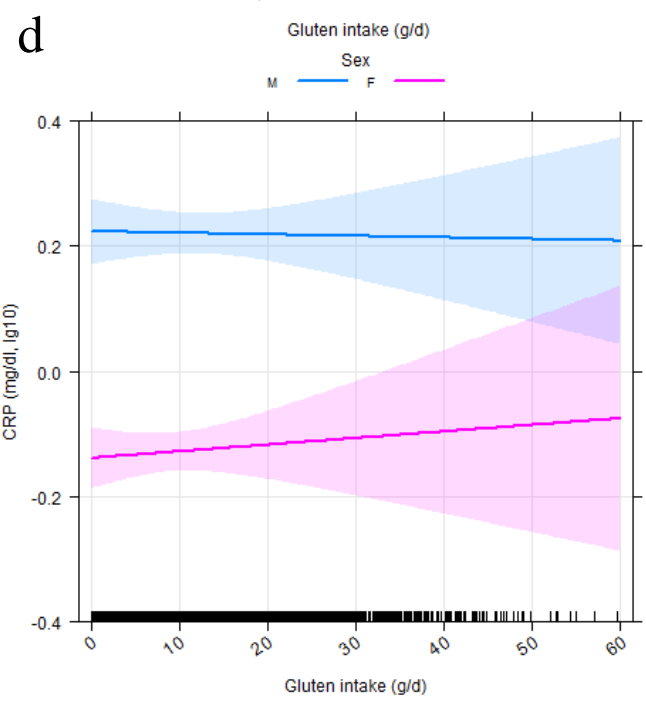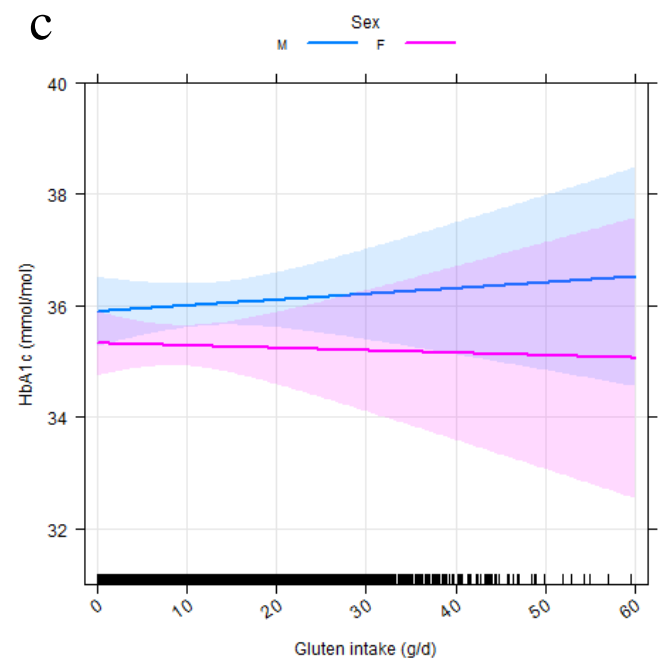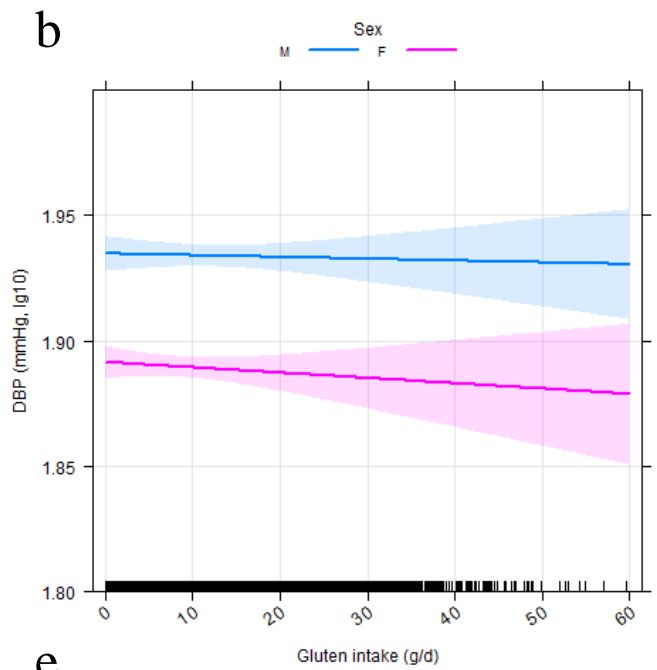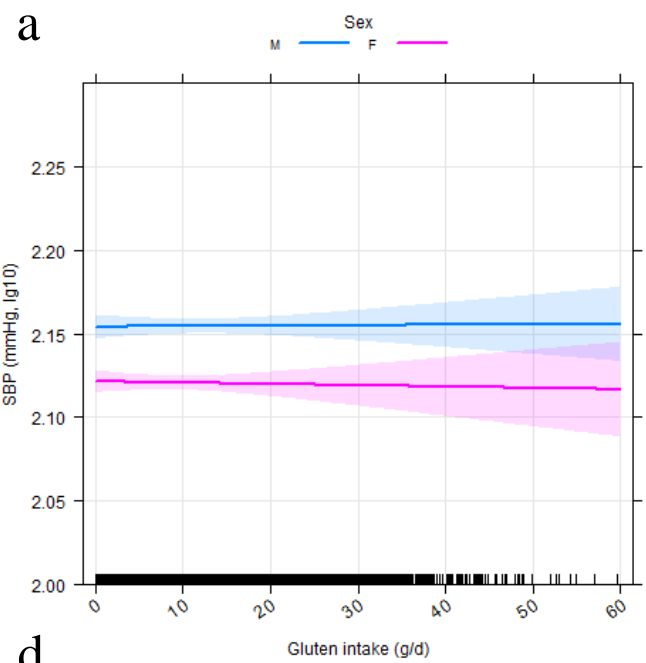
Online Resource 7

Online Resource 8

Multiple linear regression analysis using percentage body fat as the dependent variable and gluten-free diet instead of gluten intake as independent variable (n=30,460)

Independent variable	B	β	SE	t value	p value
Intercept	-2.1×10^1		2.2×10^0	-9.544	<0.0001
Gluten-free diet (reference: No GFD)					
- Yes Male	-1.1×10^0	-7.9×10^{-3}	5.7×10^{-1}	-1.938	0.0527
- Yes Female	-1.7×10^0	-2.2×10^{-2}	3.1×10^{-1}	-5.475	<0.0001
Sex (reference: Male)					
- Female	1.2×10^1	7.2×10^{-1}	7.6×10^{-2}	157.366	<0.0001
Age	4.5×10^{-1}	4.4×10^{-1}	6.0×10^{-2}	7.464	<0.0001
Age^2	-3.0×10^{-3}	-3.2×10^{-1}	5.5×10^{-4}	-5.386	<0.0001
Smoking status (reference: Never)					
- Previous	7.4×10^{-1}	4.2×10^{-2}	7.4×10^{-2}	9.947	<0.0001
- Current	-4.0×10^{-1}	-1.3×10^{-2}	1.3×10^{-1}	-3.126	0.0018
Ethnic background (reference: White)					
- Black	2.6×10^0	3.5×10^{-2}	3.0×10^{-1}	8.564	<0.0001
- Asian	1.4×10^0	2.4×10^{-2}	2.4×10^{-1}	5.826	<0.0001
- Mixed	-5.5×10^{-1}	-5.8×10^{-3}	3.8×10^{-1}	-1.422	0.1551
- Other	-4.4×10^{-1}	-4.3×10^{-3}	4.1×10^{-1}	-1.067	0.2859
Qualifications (reference: Noa)					
- Other	-8.4×10^{-1}	-2.1×10^{-2}	2.1×10^{-1}	-4.110	<0.0001
- NVQ or HND or HNC equivalent	-4.5×10^{-1}	-1.2×10^{-2}	2.0×10^{-1}	-2.269	0.0233
- CSEs or equivalent	-2.6×10^{-1}	-6.4×10^{-3}	2.1×10^{-1}	-1.234	0.2172
- O levels/GCSEs or equivalent	-6.9×10^{-1}	-3.4×10^{-2}	1.5×10^{-1}	-4.569	<0.0001
- A levels/AS levels or equivalent	-1.5×10^0	-6.2×10^{-2}	1.6×10^{-1}	-9.248	<0.0001
- College or university degree	-2.2×10^0	-1.3×10^{-1}	1.5×10^{-1}	-15.038	<0.0001
Total household income per year (£; reference: <18000)					
- 18000-30999	-1.4×10^{-1}	-7.0×10^{-3}	1.1×10^{-1}	-1.231	0.2184
- 31000-51999	-1.9×10^{-1}	-1.0×10^{-2}	1.1×10^{-1}	-1.684	0.0921
- 52000-100000	-2.8×10^{-1}	-1.5×10^{-2}	1.2×10^{-1}	-2.390	0.0169
- >100000	-9.8×10^{-1}	-3.2×10^{-2}	1.6×10^{-1}	-6.218	<0.0001
Lg_{10} Energy intake	9.0×10^0	1.1×10^{-1}	3.6×10^{-1}	24.973	<0.0001
Lg_{10} MET per week	-1.8×10^0	-1.3×10^{-2}	5.8×10^{-2}	-30.757	<0.0001

The results of the multiple linear regression analyses are expressed in terms of the non-standardized coefficient beta (B), standardized coefficient beta (β), and the adjusted coefficient of determination (R^2). Adjusted R^2=0.50, p overall model: <0.0001. Abbreviations are indicated in table 1. *SE* standard error.

Online Resource 9

Multiple linear regression analysis using gluten intake as the dependent variable ($n=30,460$)

Independent variable	B	β	SE	t value	p value
Intercept	-6.0×10^1		1.4×10^0	-43.343	<0.0001
Sex (reference: Male)					
- Female	-2.1×10^0	-1.8×10^{-1}	6.9×10^{-2}	-31.244	<0.0001
Age	-6.1×10^{-2}	-8.4×10^{-2}	4.1×10^{-3}	-14.686	<0.0001
Smoking status (reference: Never)					
- Previous	-3.5×10^{-1}	-2.8×10^{-2}	6.7×10^{-2}	-5.241	<0.0001
- Current	-3.2×10^{-1}	-1.5×10^{-2}	1.2×10^{-1}	-2.788	0.0053
Ethnic background (reference: White)					
- Black	-1.3×10^0	-2.4×10^{-2}	2.7×10^{-1}	-4.657	<0.0001
- Asian	4.2×10^{-1}	1.0×10^{-2}	2.2×10^{-1}	1.960	0.0500
- Mixed	-9.8×10^{-1}	-1.4×10^{-2}	3.5×10^{-1}	-2.814	0.0049
- Other	4.0×10^{-2}	5.5×10^{-4}	3.7×10^{-1}	0.107	0.9151
Qualifications (reference: Noa)					
- Other	-5.1×10^{-1}	-1.8×10^{-2}	1.9×10^{-1}	-2.719	0.0066
- NVQ or HND or HNC equivalent	-1.6×10^{-1}	-5.7×10^{-3}	1.8×10^{-1}	-0.856	0.3922
- CSEs or equivalent	-1.5×10^{-1}	-5.1×10^{-3}	1.9×10^{-1}	-0.792	0.4287
- O levels/GCSEs or equivalent	-4.7×10^{-1}	-3.1×10^{-2}	1.4×10^{-1}	-3.394	0.0007
- A levels/AS levels or equivalent	-6.4×10^{-1}	-3.7×10^{-2}	1.5×10^{-1}	-4.385	<0.0001
- College or university degree	-5.2×10^{-1}	-4.3×10^{-2}	1.3×10^{-1}	-3.918	<0.0001
Total household income per year (£; reference: <18000)					
- 18000-30999	-2.9×10^{-1}	-2.1×10^{-2}	1.0×10^{-1}	-2.915	0.0036
- 31000-51999	-6.7×10^{-1}	-5.0×10^{-2}	1.0×10^{-1}	-6.636	<0.0001
- 52000-100000	-9.0×10^{-1}	-6.4×10^{-2}	1.1×10^{-1}	-8.364	<0.0001
- >100000	-1.5×10^0	-6.7×10^{-2}	1.4×10^{-1}	-10.458	<0.0001
Lg_{10} Energy intake	1.9×10^1	3.3×10^{-1}	3.3×10^{-1}	58.904	<0.0001
Lg_{10} MET per week	-8.4×10^{-2}	-8.2×10^{-3}	5.3×10^{-2}	-1.583	0.1135

The results of the multiple linear regression analyses are expressed in terms of the non-standardized coefficient beta (B), standardized coefficient beta (β), and the adjusted coefficient of determination (R^2). Adjusted $R^2=0.20$, p overall model: <0.0001. Abbreviations are indicated in table 1. *SE* standard error.