- Diet score:
  - What we tried
  - Issues
  - Final diet score
- Environment score
- Selecting persistently lean individuals with an obesogenic lifestyle

Data

- All datasets consist of subjects who:
  - have nationality data available and are Swedish
  - have the visit variable(besok) available
  - have sufficient diet data in the first place(looking at the variable *exclude*)
  - have a plausible energy intake, based on their basal metabolic rate(looking at the variable *FIL*)
  - have values of basic variables like height, weight, waist, etc. inside the recommended limit values
  - have all the basic data and the macro and micro nutrient, PA and alcohol data available.
- Two datasets were constructed, an independent dataset and a dataset containing subjects with two visits [9,11] years apart.
- Out of 111505 subjects total, independent dataset has 44735 subjects, dataset with two visits has 30380 subjects.

Diet score

- We had tried:
  - constructing diet score using categorized macro and micro nutrients, based on the guidelines stated at Nordic Nutrition Recommendations, multiplied with the appropriate effect size on bmi and summed up,
  - constructing diet score using combined food items based on the healthy diet score used in publications, multiplied with the appropriate effect size on bmi and summed up,
  - constructing diet score using continuous macro and micro nutrient, multiplied with the appropriate effect size on bmi and summed up

Diet score

- Issues:
  - Recommendations and published diet scores do not completely fit our needs to construct an obesogenic diet score,
  - Recommendations did not cover all the macro or micro nutrients,
  - Categorization of continuous variables resulted in loss of information,
  - Recommendations, published diet scores and diet models are simple and general, not considering food synergy or antagonism and not considering nutrient effect by food source,
  - Observed unexpected directions of association with bmi,
  - Many model selection and effect size estimation methods,
  - Even the best model did not have very good results(low R^2 and AUC).

Diet score

- Results for categorized BMI (0=Normal or underweight, 1=overweight, 2=obese):

Visit 1	Diet effect size		Diet p-value	AUC	R^2	AIC
Basic model	-	-	-	0.6206	0.0286	54,872
Separate effects	0.273 (1)	0.556 (2)	<2e-16	0.6354	0.0365	54,431
Shrunken joint effects(best α = 0.2)	1.807 (1)	3.675 (2)	<2e-16	0.6471	0.0439	54,009
Joint effects	1.263 (1)	2.530 (2)	<2e-16	0.6488	0.0449	53,955

Visit 2	Diet effect size		Diet p-value	AUC	R^2	AIC
Basic model	-	-	-	0.6040	0.0197	61,884
Separate effects	0.350 (1)	0.783 (2)	<2e-16	0.6259	0.0294	61,279
Shrunken joint effects(best α = 0.2)	1.651 (1)	3.671 (2)	<2e-16	0.6394	0.0376	60,757
Joint effects	1.358 (1)	3.005 (2)	<2e-16	0.6417	0.0392	60,656

Diet score

- Final diet score was constructed using the unshrunken effect sizes where all the macro and micro nutrients were fitted together to model the residuals from modeling BMI with basic covariates.
- Significant macro nutrients and TEI:

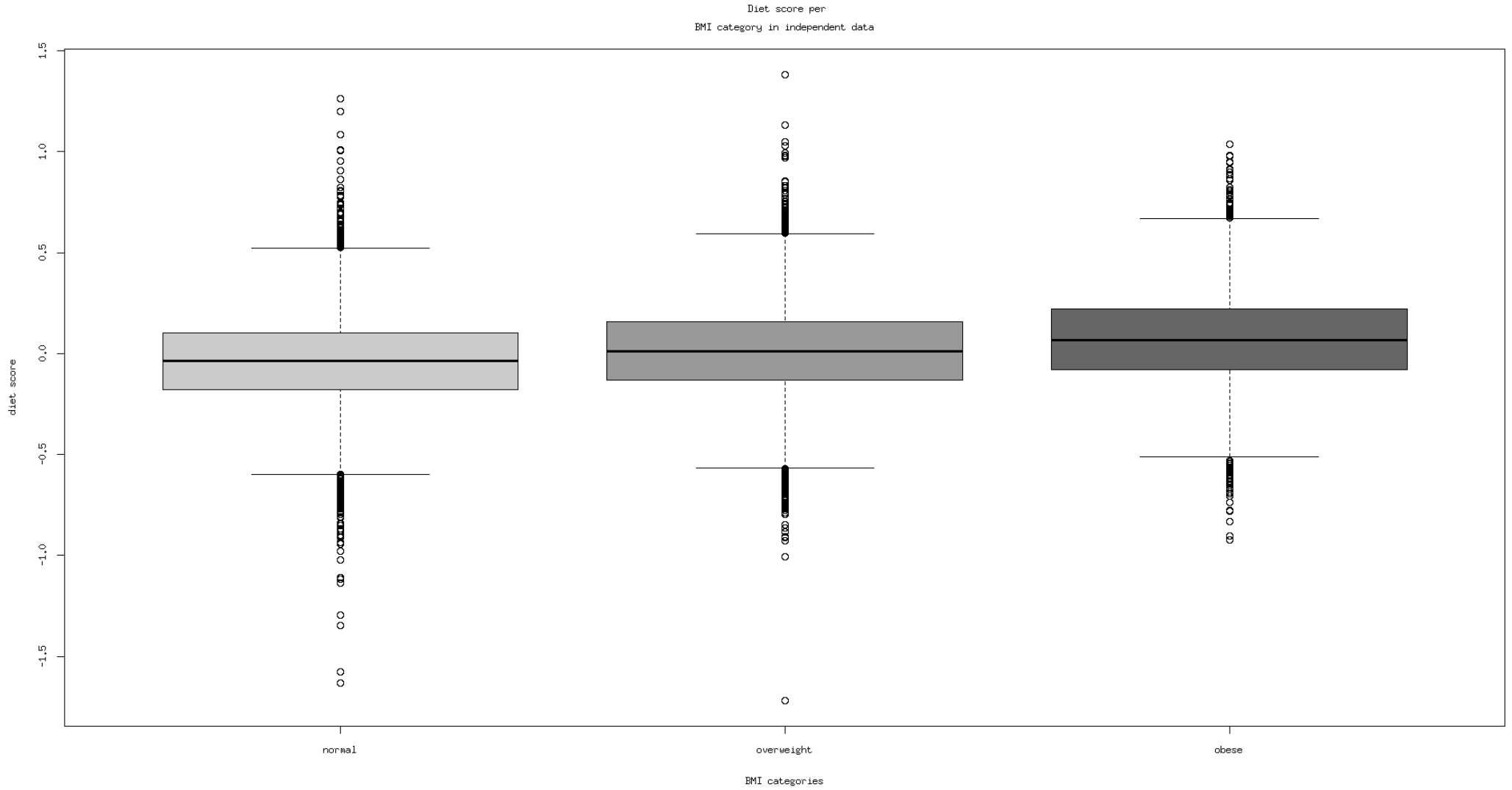
	effect size	p-value	vif
Polyunsaturated fat	0.172	2.868733e-06	33.072674
Saturated fat	-0.225	7.580582e-06	44.209620
Sucrose	-0.098	1.122240e-09	8.593770
Carbohydrates	-0.102	2.062294e-03	14.823591
Essential fatty acids	-0.195	5.187166e-10	25.861051
Animal proteins	0.213	8.985754e-16	15.442719
Fiber	0.080	2.030805e-05	10.879772
Disaccharides	0.170	1.569436e-15	12.106861
Trans fat	-0.032	1.116558e-04	2.307944
Salt (sodium)	0.203	5.061785e-35	3.603837
Total energy intake	0.013	4.211870e-03	1.000033

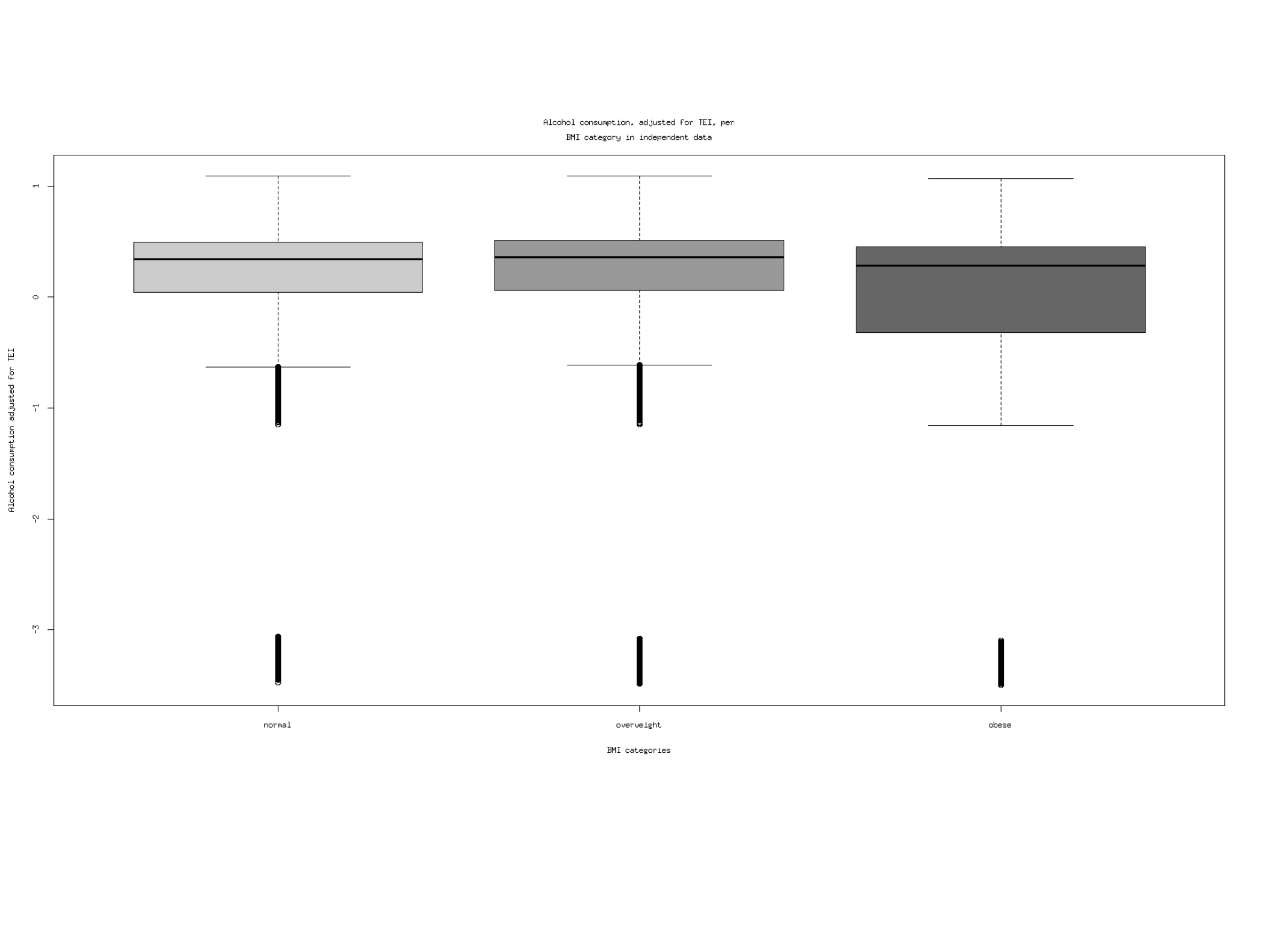
Environment score

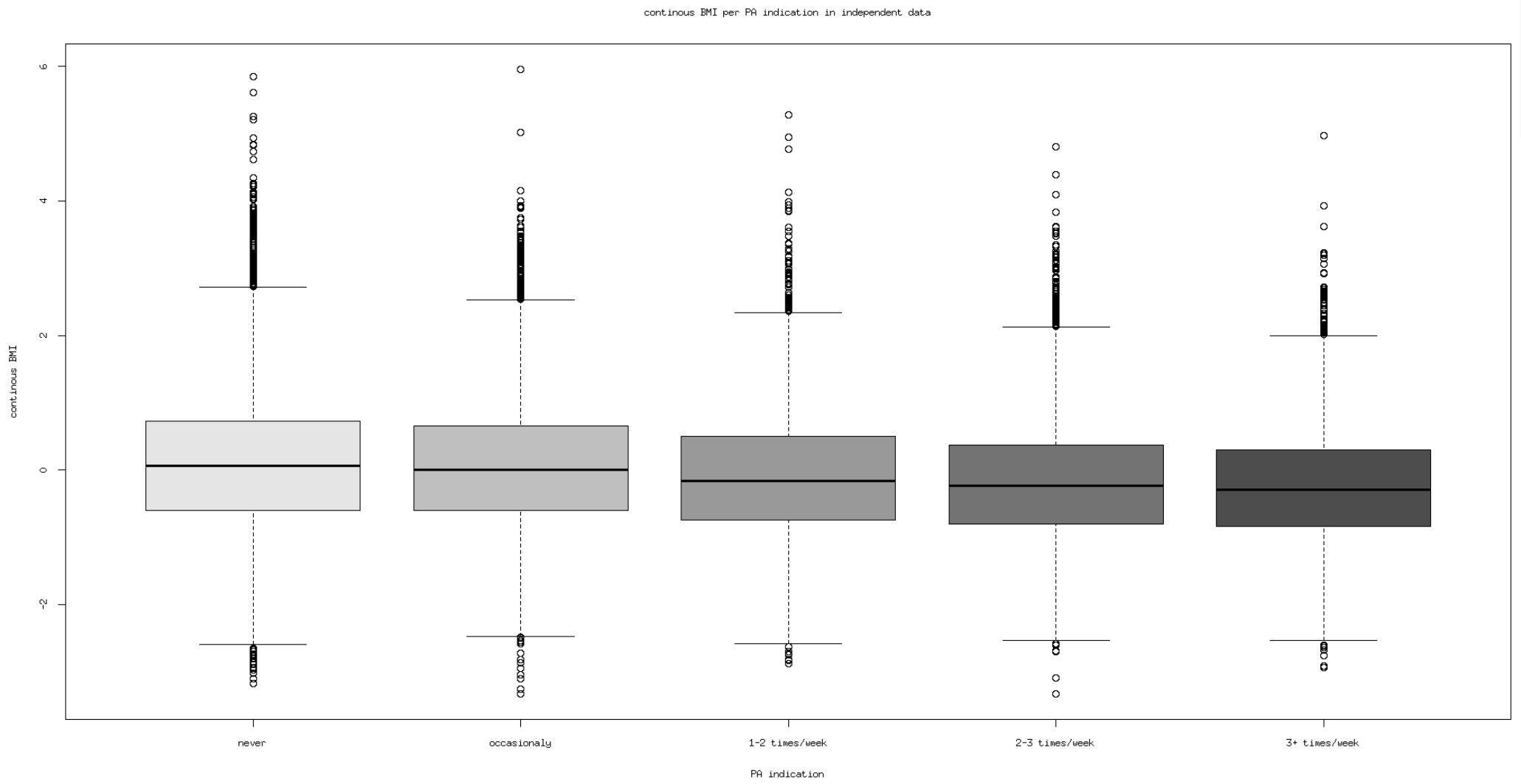
- Similar was done for diet score, PA and alcohol consumption, obtaining effect sizes and using them to multiply corresponding variable and then summing all up:

	effect size	p-value	Variable summary
Diet score	0.876992	<2e-16	[-1.719 , 1.383]
PA	-0.081397	<2e-16	[1, 2, 3, 4, 5]
alcohol	-0.041880*	<2e-16	[-3.496 , 1.093]

*we tried to investigate confounding factors influencing the effect of alcohol on bmi, focusing on the socio-economic status, represented by the variable for education, but were not able to confirm confounding.


Diet score per
BMI category in independent data
diet score
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
normal
overweight
obese
BMI categories


Alcohol consumption, adjusted for TEI, per
BMI category in independent data
Alcohol consumption adjusted for TEI
1
0
-1
-2
-3
normal
overweight
obese
BMI categories

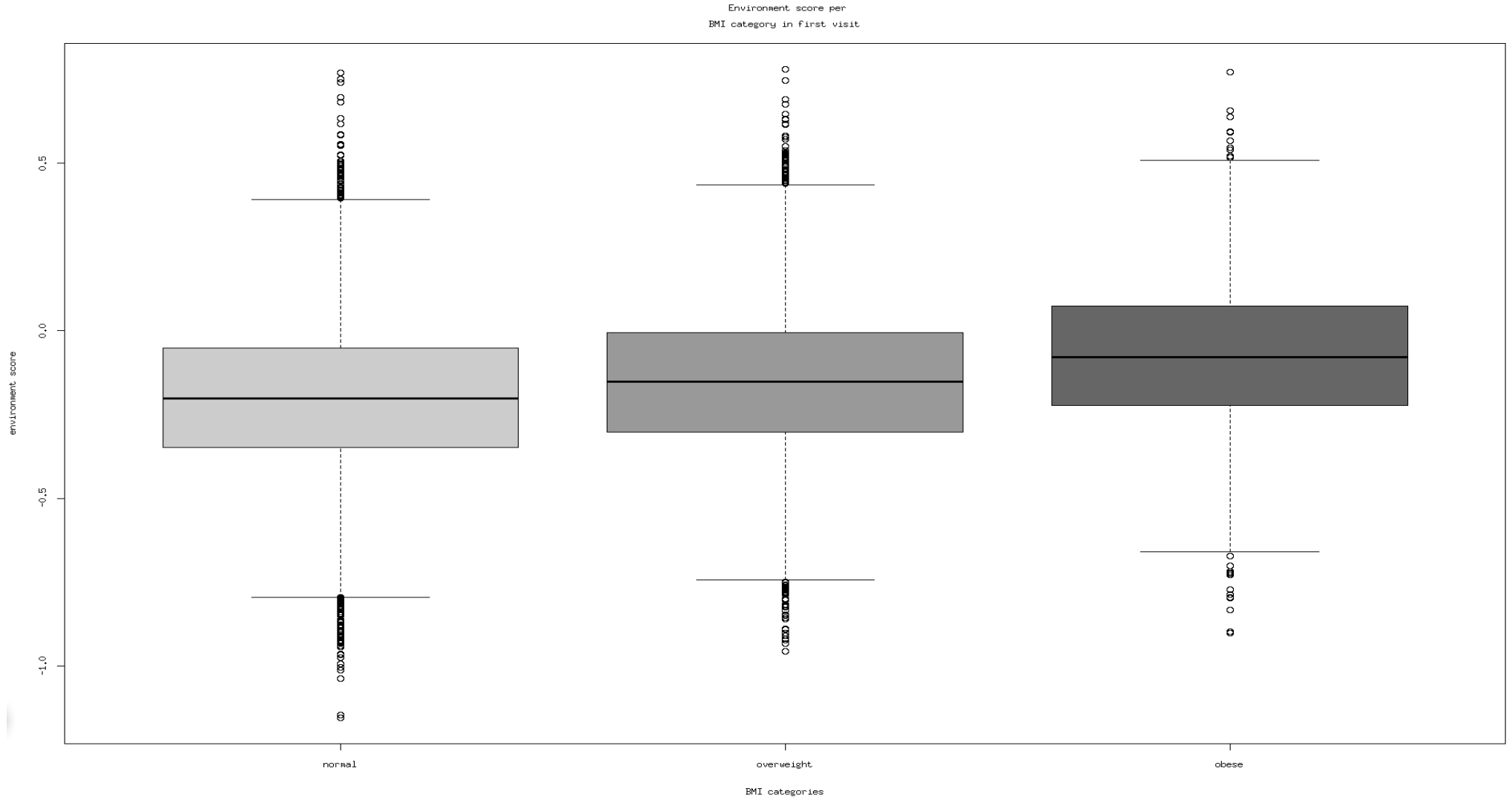

continous BMI per PA indication in independent data
continous BMI
6
4
2
0
-2
never
occasionaly
1-2 times/week
2-3 times/week
3+ times/week
PA indication

Environment score

- Results for the model:

	continous		
	R^2	Environment effect size	p-value
Visit 1	0.04057	0.866377	<2e-16
Visit 2	0.05668	1.002757	<2e-16

	discrete				
	R^2	Environment effect size		p-value	AUC
Visit 1	0.0496214	1.369 (1)	2.893 (2)	<2e-16	0.655383
Visit 2	0.0450873	1.248 (1)	2.976 (2)	<2e-16	0.6491333


Environment score per
BMI category in first visit
environment score
0.5
0.0
-0.5
-1.0
normal
overweight
obese
BMI categories

Selecting subjects of interest

- Based on the environment score and bmi in both visits, we have to select subjects that are persistently lean/normal weight, despite having an obesogenic environment score.

- We had considered:
  - Setting a cut-off point in the environment score and defining all values above as obesogenic and select lean/normal weight subjects with the environment score above that value,
  - Obtain the ratio $\frac{bmi\ Z\ score}{environment\ Z\ score}$ and set a cut-off point somewhere below one, to select those subjects whose environment z-score is substantially larger than their bmi z-score,
  - Selecting those lean/normal weight subjects that are persistently misclassified as overweight or obese.

predicted \ true	0	1	2
0	14090	7122	1771
1	2688	3632	809
2	5	0	1