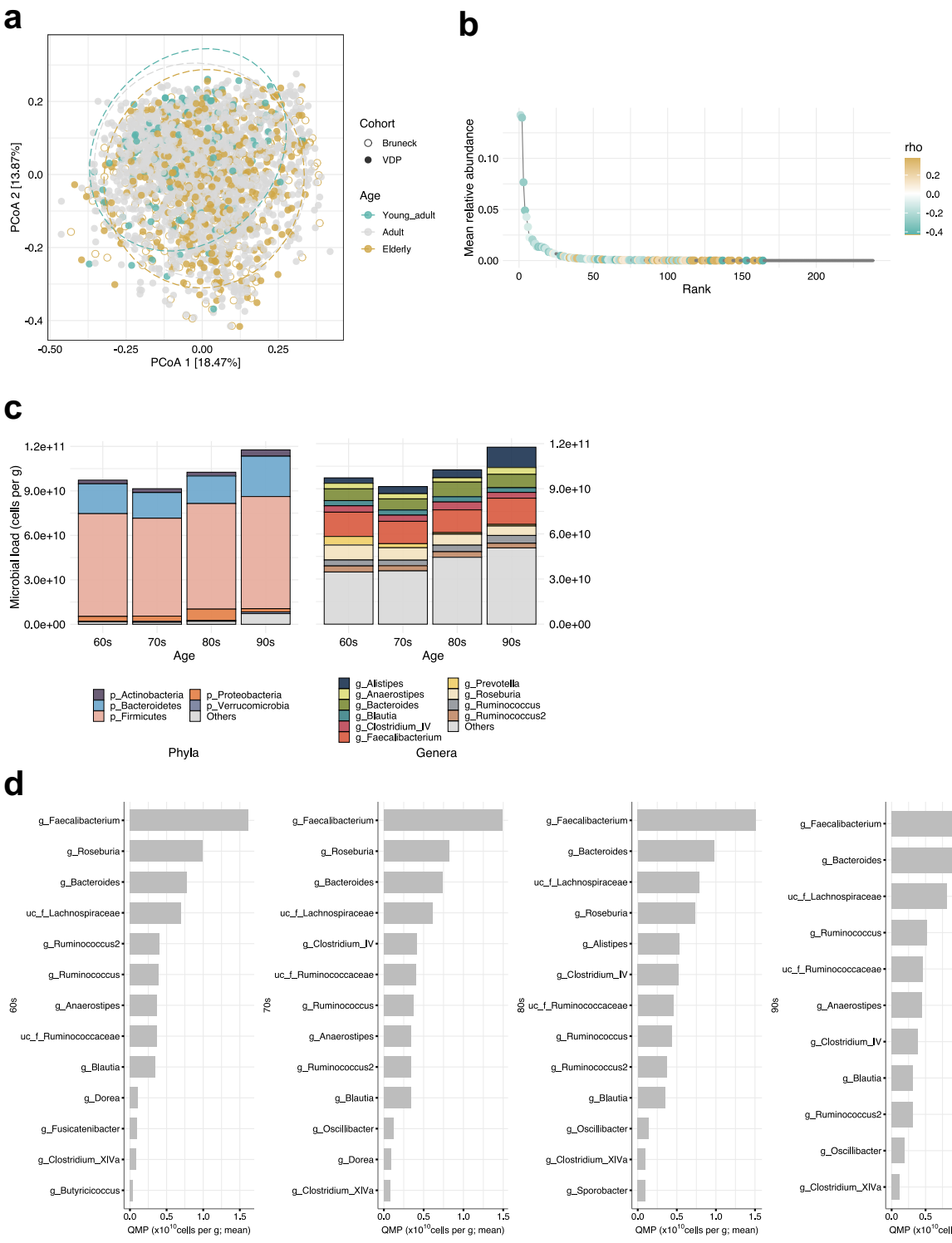
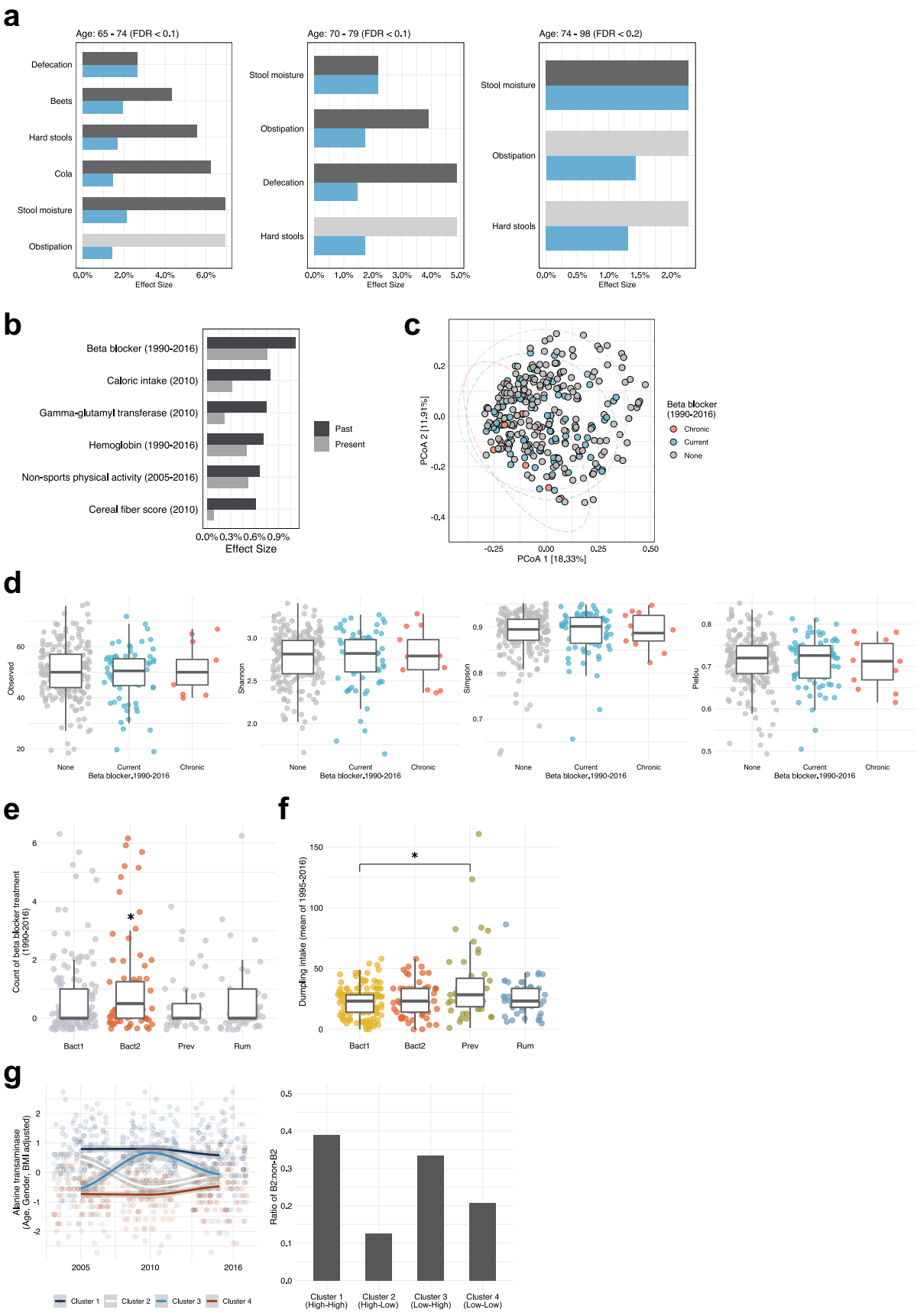
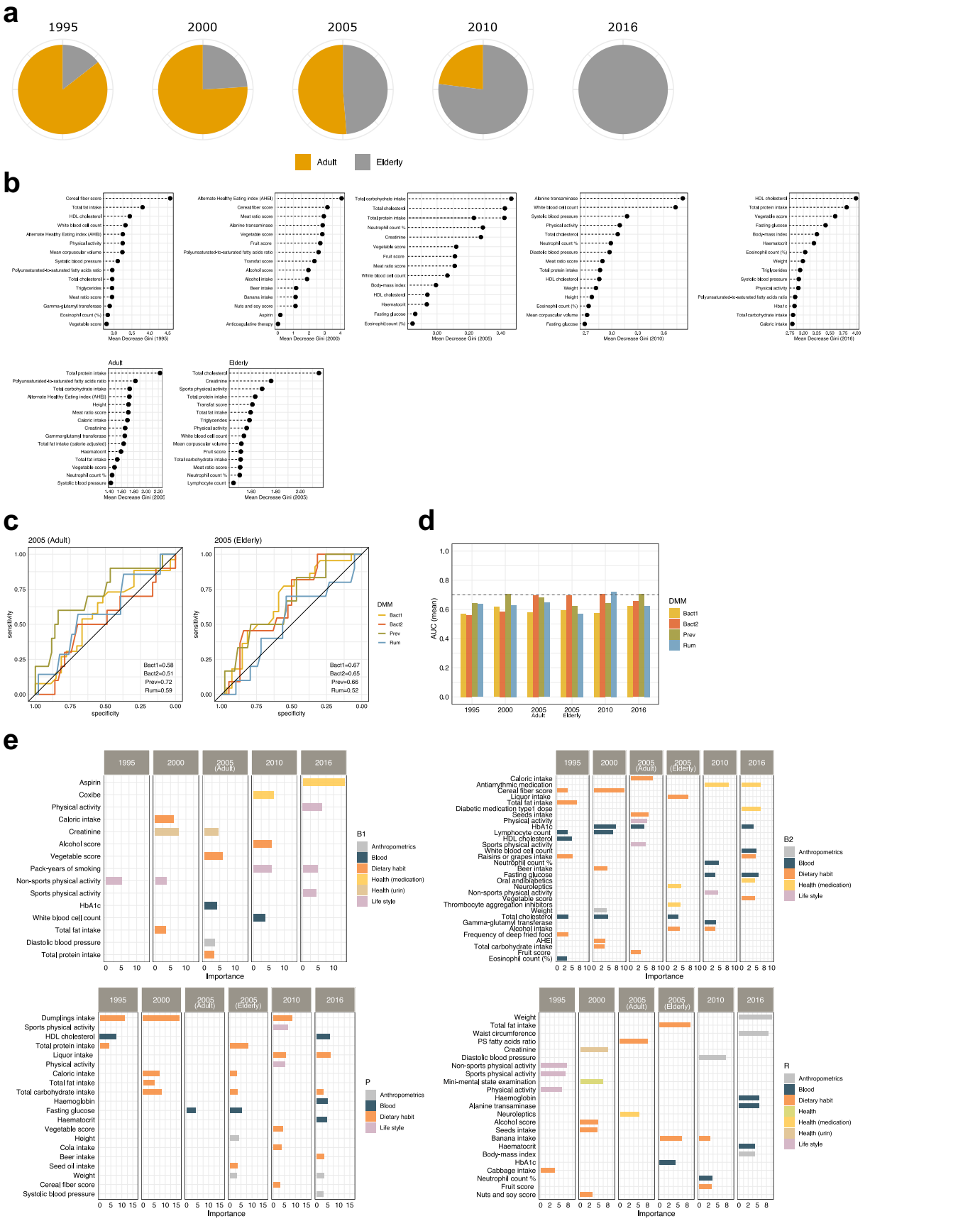

a
PCoA 2 [13.87%]
PCoA 1 [18.47%]
Cohort
Bruneck
VDP
Age
Young_adult
Adult
Elderly
b
Mean relative abundance
Rank
rho
c
Microbial load (cells per g)
Age
Phyla
p_Actinobacteria
p_Bacteroidetes
p_Firmicutes
p_Proteobacteria
p_Verrucomicrobia
Others
Genera
g_Alistipes
g_Anaerostipes
g_Bacteroides
g_Blautia
g_Clostridium_IV
g_Faecalibacterium
g_Prevotella
g_Roseburia
g_Ruminococcus
g_Ruminococcus2
d
60s
70s
80s
90s
QMP (x10^10 cells per g; mean)

Extended Data Fig. 1. Microbial characteristics of elderly community. (a) Microbial composition by age categories (Adonis r2 = 0.006, p = 0.001) based on relative microbial profiling (RMP). Young adults: 18 ≤ age < 30, adults: 30 ≤ age <65, elderly: 65 ≤ age. Principal coordinate analysis (PCoA) was performed using Bray-Curtis dissimilarity. (b) Rank abundance plot of genera associated with age in the elderly subjects (age ≥ 65). Taxonomic abundances were centered log-ratio (clr) transformed and adjusted for gender, BMI, antibiotics intake, and stool moisture (rho range = -0.43-0.37, FDR < 0.1). Green and brown dots indicate genera negatively and positively correlated with age, respectively. (c) Quantitative profiling of phyla, genera, and (d) core taxa (95% of prevalence) in the Bruneck Study cohorts (n = 304) across decadal age groups.


a
Age: 65 - 74 (FDR < 0.1)
Defecation
Beets
Hard stools
Cola
Stool moisture
Obstipation
0.0% 2.0% 4.0% 6.0%
Effect Size
Age: 70 - 79 (FDR < 0.1)
Stool moisture
Obstipation
Defecation
Hard stools
0.0% 1.0% 2.0% 3.0% 4.0% 5.0%
Effect Size
Age: 74 - 98 (FDR < 0.2)
Stool moisture
Obstipation
Hard stools
0.0% 0.5% 1.0% 1.5% 2.0%
Effect Size
b
Beta blocker (1990-2016)
Caloric intake (2010)
Gamma-glutamyl transferase (2010)
Hemoglobin (1990-2016)
Non-sports physical activity (2005-2016)
Cereal fiber score (2010)
0.0% 0.3% 0.6% 0.9%
Effect Size
Past
Present
c
PCoA 2 [11.91%]
PCoA 1 [18.33%]
Beta blocker (1990-2016)
Chronic
Current
None
d
Observed
Shannon
Simpson
Pielou
None
Current
Chronic
Beta blocker.1990-2016
e
Count of beta blocker treatment (1990-2016)
Bact1
Bact2
Prev
Rum
f
Dumping intake (mean of 1995-2016)
Bact1
Bact2
Prev
Rum
g
Alanine transaminase (Age, Gender, BMI adjusted)
2005
2010
2016
Cluster 1
Cluster 2
Cluster 3
Cluster 4
Ratio of B2:non-B2
Cluster 1 (High-High)
Cluster 2 (High-Low)
Cluster 3 (Low-High)
Cluster 4 (Low-Low)

Extended Data Fig. 2. Variables driving the Bruneck elderly gut community variation. (a) Each age window includes the same number of elderly subjects (n = 156). Blue: individual effect size. Dark grey: cumulative effect size. Light grey: cumulative effect size – not included in the forward stepwise RDA model. (b) Comparison of individual effect size of historical parameters and contemporary covariates. (c) Ordination plot by beta blocker treatment (PCoA based on Bray-Curtis dissimilarity; Adonis r2 = 0.013, $p < 0.001$). (d) Biodiversity of individuals by beta blocker treatment. None are significant. Comparison of (e) beta blocker treatment and (f) averaged dumpling intake between enterotypes. *, FDR <0.1 by Kruskal–Wallis test followed by post-hoc Dunn's test. Boxes represent the 25th percentile, median, and 75th percentile. Whiskers represent the lowest and highest values of the data. (g) Clusters of alanine transaminase across the years. Cluster 1: high in the past and at present; Cluster 2: high in the past and low at present; Cluster 3: low in the past and high at present; Cluster 4: low in the past and at present. Comparisons of ratio of B2 and non-B2 by clusters were plotted by bar graphs. None are significant.


a
1995
2000
2005
2010
2016
Adult
Elderly
b
Mean Decrease Gini (1995)
Mean Decrease Gini (2000)
Mean Decrease Gini (2005)
Mean Decrease Gini (2010)
Mean Decrease Gini (2016)
Adult
Elderly
Mean Decrease Gini (2005)
c
2005 (Adult)
2005 (Elderly)
sensitivity
specificity
Bact1=0.58
Bact2=0.51
Prev=0.72
Rum=0.59
Bact1=0.67
Bact2=0.65
Prev=0.66
Rum=0.52
DMM
Bact1
Bact2
Prev
Rum
d
AUC (mean)
DMM
Bact1
Bact2
Prev
Rum
e
Importance
B1
B2
P
R
Anthropometrics
Blood
Dietary habit
Health (medication)
Health (urin)
Life style
Health

Extended Data Fig. 3. Prediction variables of current microbiome using past variables. (a) The year 2005 has overall lower predictive power because it is a switching year in age demographics. It is a transition year between the younger adults (age < 65) and the elderly (age ≥ 65) subjects. This year, the proportion between the two groups becomes approximately 50:50 while the ratio is 75:25 or 85:15 for other years (either dominated by adults or elderly depending on the year). Therefore, the year 2005 was analyzed separately by the different age groups (the adults vs. the elderly). (b) The 15 most discriminatory variables for the enterotypes ranked by descending order of Mean Decrease Gini. (c) Receiver operating curve (ROC) for the evaluations 1995, 2000, 2005, 2010 and 2016 using the test dataset (n =101). (d) Area under the curve (AUC) obtained by 10-fold cross validation. Dashed line indicates AUC = 0.7. (e) Variables selected for enterotypes. Colors indicate different categories of the variables.