

Supplementary material

A 50 repeats of the randomly partition process

We performed an analysis using 50 random seeds to partition the healthy population into three subsets, repeating the entire process for each seed. For sick condition, Figures 1, 2, and 3 show that the top four most frequently occurring abnormal symptoms for coronary heart disease (CHD) across all folds are: “MedicalConstipation=1,” “Sleep=1,” “MotorFunction=1,” and “MasticatoryFunction=1.” In Fold 1 (Figure 1), the factor “SocialFunction=1” appears only once, thus it is considered negligible.

In contrast, Figures 4, 5, and 6 highlight the top five most frequently occurring factors for healthy condition in each fold: “MotorFunction=0,” “EducationLevel=3,” “Sleep=0,” “MasticatoryFunction=0,” and “MasticatoryFunction=0.” These findings are consistent across all random seeds.

These consistent results suggest that the random split approach is a reliable technique for uncovering meaningful patterns in the data, ensuring that the conclusions drawn are not influenced by arbitrary data partitioning.

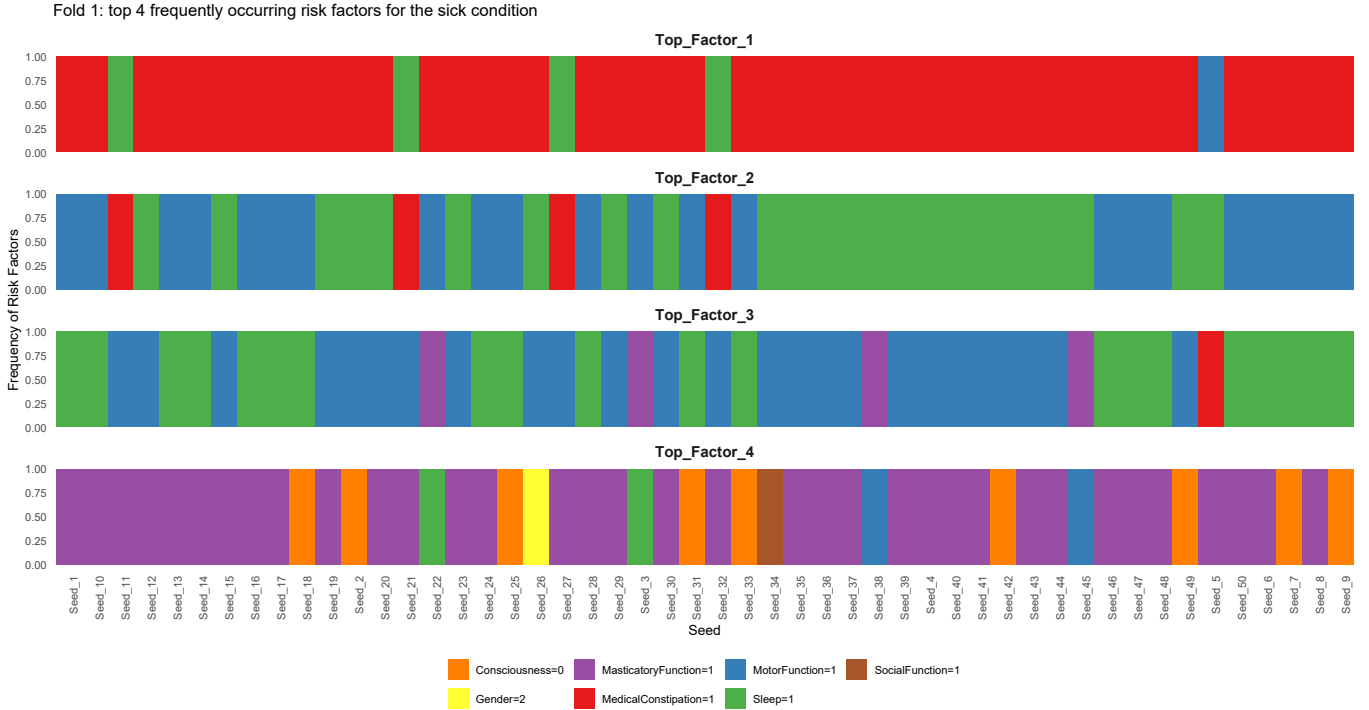


Figure 1: The top 4 frequently occurring factors across seeds for the sick condition in Fold 1.

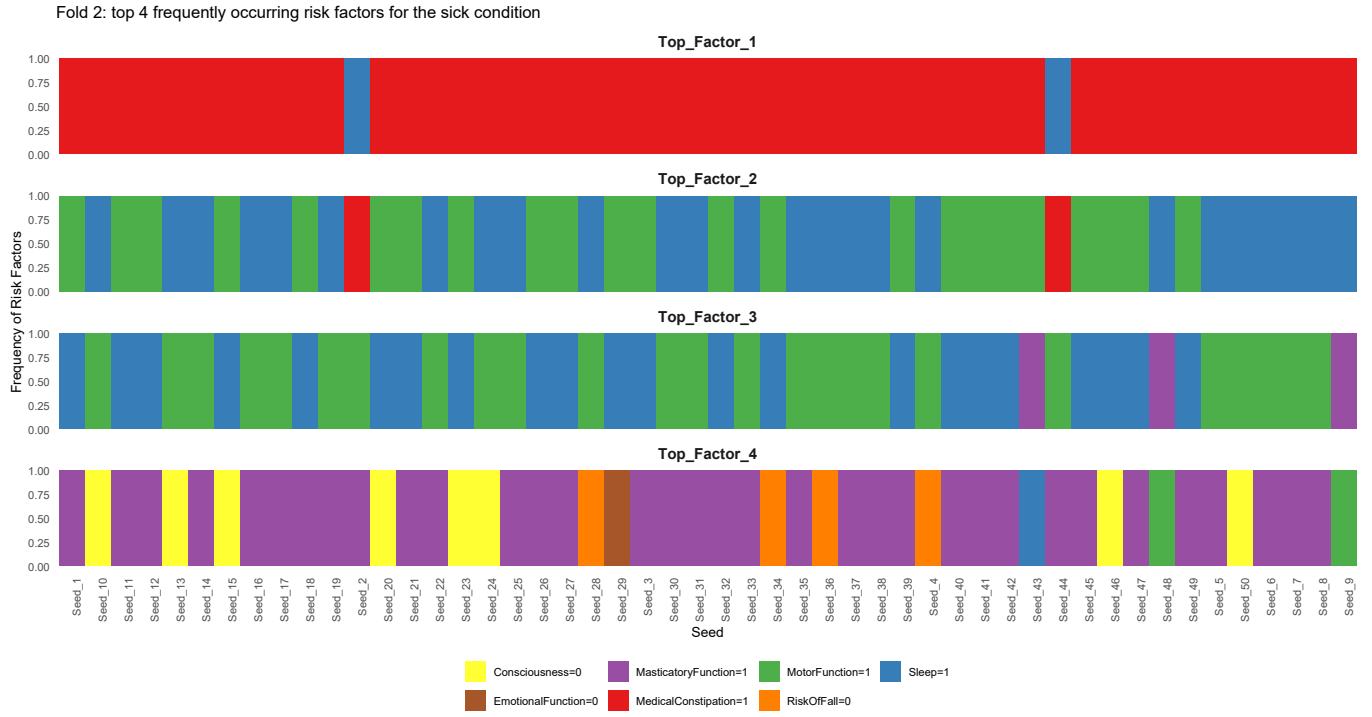


Figure 2: The top 4 frequently occurring factors across seeds for the sick condition in Fold 2.

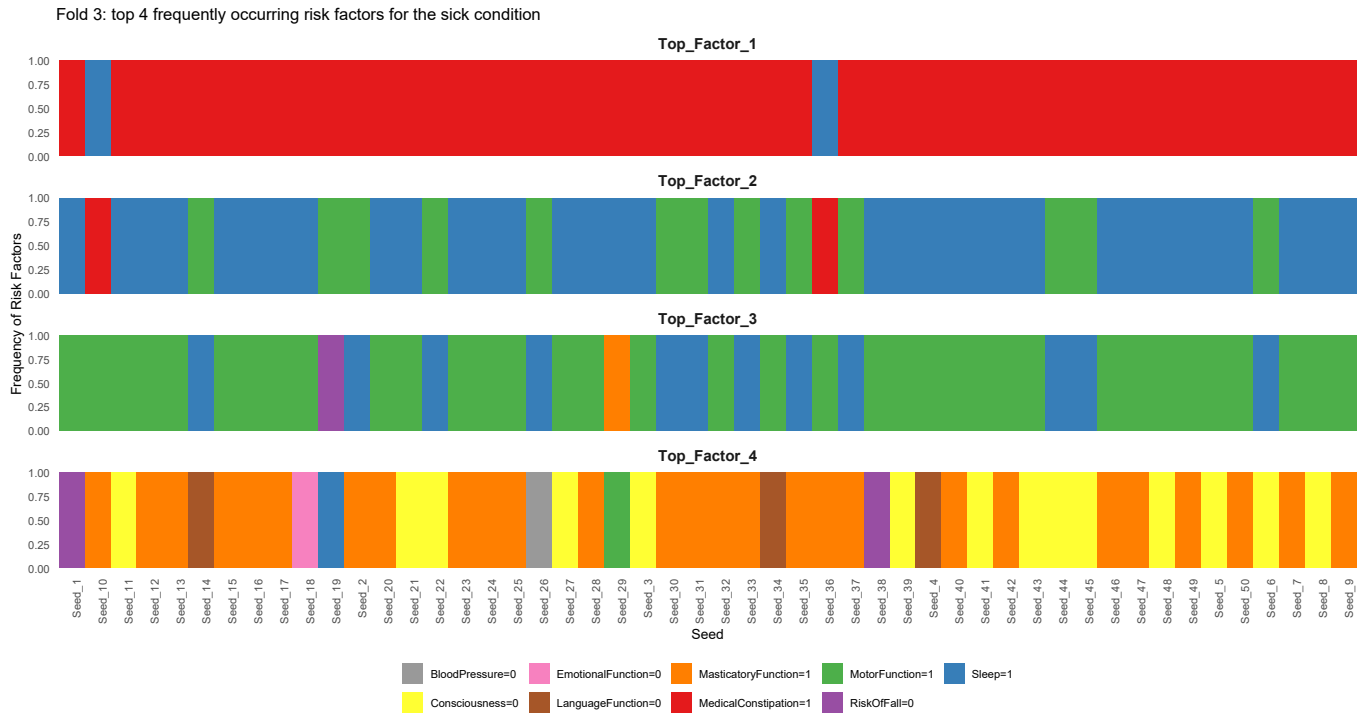


Figure 3: The top 4 frequently occurring factors across seeds for the sick condition in Fold 3.

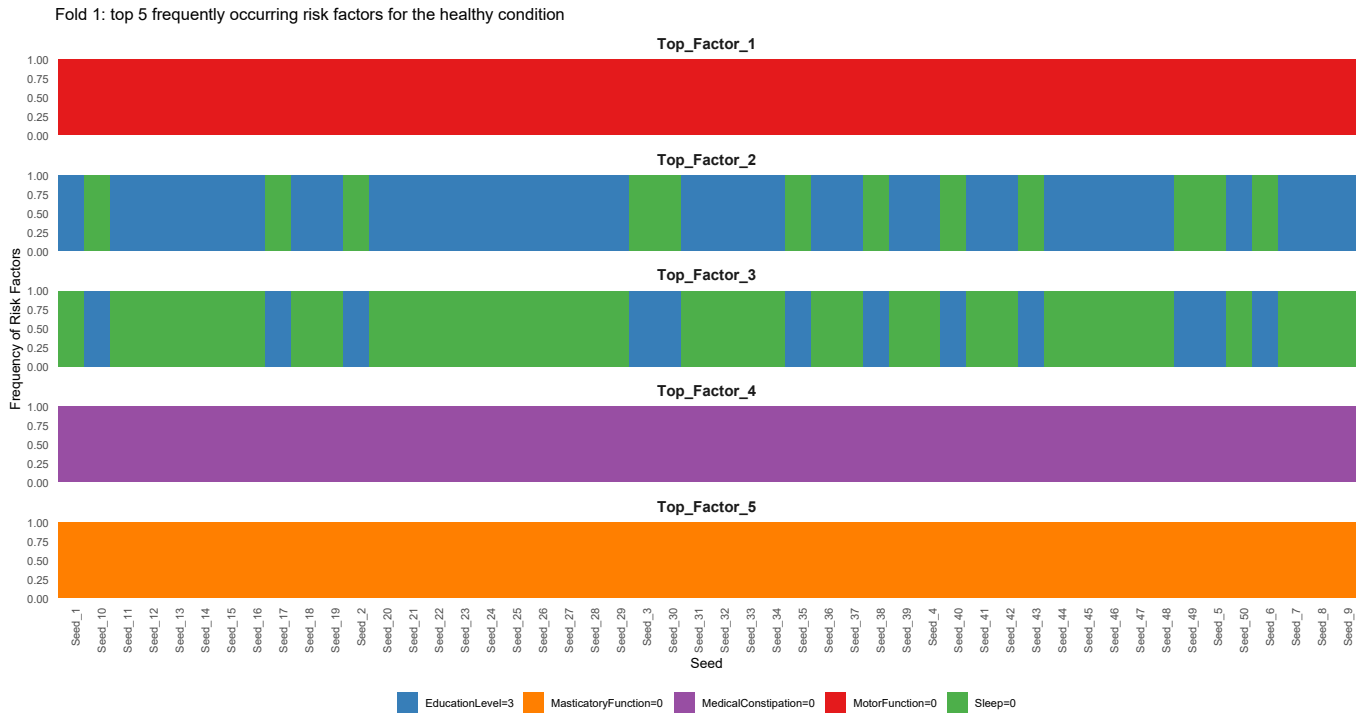


Figure 4: The top 5 frequently occurring factors across seeds for the healthy condition in Fold 1.

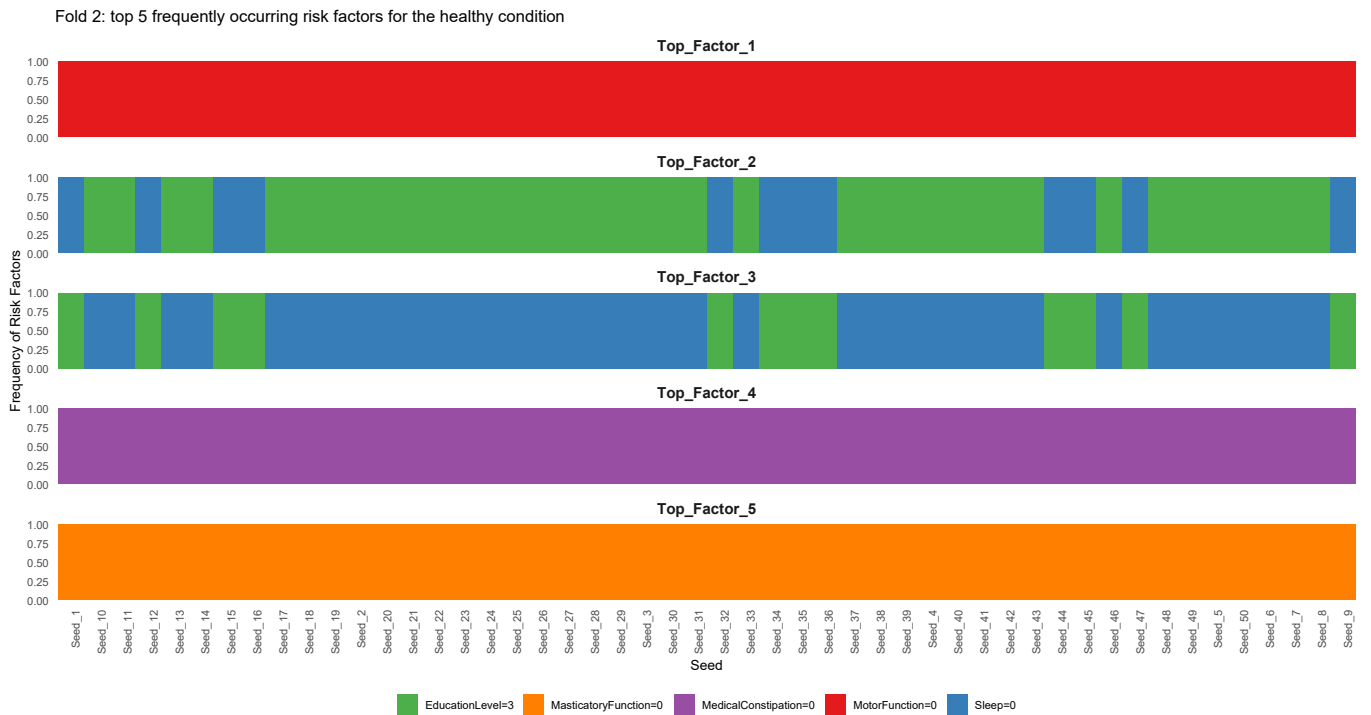


Figure 5: The top 5 frequently occurring factors across seeds for the healthy condition in Fold 2.

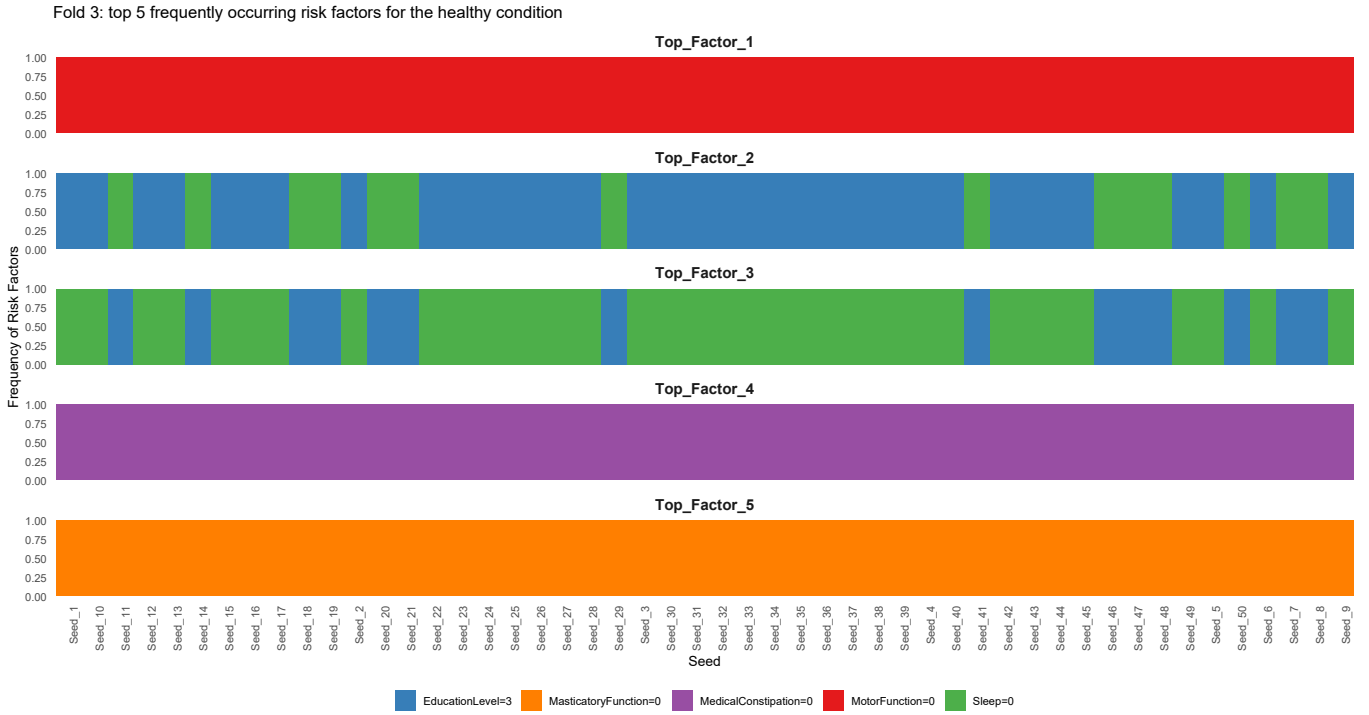


Figure 6: The top 5 frequently occurring factors across seeds for the healthy condition in Fold 3.

B Sensitivity analysis

To conduct sensitivity analyses, the data were divided into subgroups based on key demographic attributes: gender (female and male) and age (60–80, 80–90, and 90+ years). The complete analysis was then repeated for each subgroup to evaluate potential variations in the results.

B.1 Gender

For the sick condition, the top four most frequently occurring abnormal factors are presented in Table 1. For the healthy condition, the top five most frequently occurring factors are shown in Table 2. As observed, there are no significant differences in CHD risk factors between females and males. Furthermore, the identified risk factors remain consistent when analyzing the entire dataset.

Table 1: The top 4 frequently occurring abnormal factors for the sick condition when subgrouped by gender. The total number of significant rules and the frequency of factors appearing across all rules are presented.

Fold 1			
Female (3849)		Male (4142)	
Factors	Count (%)	Factors	Count (%)
MedicalConstipation=1	2540 (65.99)	Sleep=1	2239 (54.06)
Sleep=1	1256 (32.63)	MedicalConstipation=1	2209 (53.33)
MasticatoryFunction=1	1130 (29.36)	MotorFunction=1	1835 (44.30)
MotorFunction=1	1065 (27.67)	MasticatoryFunction=1	828 (19.99)
Fold 2			
Female (3988)		Male (1003)	
Factors	Count (%)	Factors	Count (%)
MedicalConstipation=1	2399 (60.16)	MotorFunction=1	918 (91.53)
Sleep=1	1509 (37.84)	Sleep=1	624 (62.21)
MotorFunction=1	1466 (36.76)	MedicalConstipation=1	548 (54.64)
MasticatoryFunction=1	1095 (27.46)	MasticatoryFunction=1	12 (1.20)
Fold 3			
Female (5115)		Male (2016)	
Factors	Count (%)	Factors	Count (%)
MedicalConstipation=1	3658 (71.52)	Sleep=1	1474 (73.12)
MotorFunction=1	1406 (27.49)	MotorFunction=1	1216 (60.32)
Sleep=1	1379 (26.96)	MedicalConstipation=1	1118 (55.46)
MasticatoryFunction=1	1379 (25.65)	MasticatoryFunction=1	255 (12.65)

Table 2: The top 5 frequently occurring factors for the healthy condition when subgrouped by gender.

Fold 1			
Female(3770)		Male(6179)	
Factors	Count (%)	Factors	Count (%)
MotorFunction=0	2457(65.17)	MotorFunction=0	4383(70.93)
EducationLevel=3	2401(63.69)	EducationLevel=3	3147(50.93)
Sleep=0	2156(57.19)	Sleep=0	2468(39.94)
MedicalConstipation=0	1212(32.15)	MedicalConstipation=0	2197(35.56)
MasticatoryFunction=0	879(23.32)	MasticatoryFunction=0	1682(27.22)
Fold 2			
Female(3939)		Male(5288)	
Factors	Count (%)	Factors	Count (%)
MotorFunction=0	2666(67.68)	MotorFunction=0	4284(81.01)
EducationLevel=3	2365(60.04)	EducationLevel=3	2347(44.38)
Sleep=0	2231(56.64)	Sleep=0	2050(38.77)
MedicalConstipation=0	1259(31.96)	MedicalConstipation=0	1820(34.42)
MasticatoryFunction=0	912(23.15)	MasticatoryFunction=0	1644(31.09)
Fold 3			
Female(3957)		Male(5746)	
Factors	Count (%)	Factors	Count (%)
MotorFunction=0	2698(68.18)	MotorFunction=0	4329(75.34)
EducationLevel=3	2321(58.66)	EducationLevel=3	2768(48.17)
Sleep=0	2246(56.76)	Sleep=0	2309(40.18)
MedicalConstipation=0	1299(32.83)	MedicalConstipation=0	1982(34.49)
MasticatoryFunction=0	905(22.87)	MasticatoryFunction=0	1673(29.12)

B.2 Age

For each age-based subgroup, Tables 3 and 4 present the most frequently occurring factors associated with sick and healthy conditions, respectively. Overall, the risk factors for CHD closely align with those identified using the entire dataset, with only two notable variations observed between subgroups.

- 1) As shown in Table 3, elderly individuals with CHD aged 60 to 80 appear to have no significant issues with masticatory function. No significant masticatory issues in this group suggest that chewing dysfunction doesn't significantly affect CHD risk here. They may maintain a balanced diet, which helps manage cardiovascular health. In contrast, those aged over 80 who experience masticatory dysfunction are more likely to have CHD. Masticatory dysfunction in this group is linked to CHD because it can lead to poor nutrition and dietary limitations, which may exacerbate cardiovascular problems.
- 2) As shown in Table 4, a relatively higher education level ("EducationLevel=3" or "EducationLevel=4") is associated with a lower risk of having CHD, but this correlation only appears in individuals aged 60 to 80. This correlation may be weaker in older groups due to different influencing factors, like genetics or aging-related health decline.

Table 3: The top four most frequently occurring abnormal factors, along with the gender factor, for the sick condition categorized by age subgroup.

Fold 1					
60-80 (3090)		80-90 (4704)		90+ (4197)	
Factors	Count (%)	Factors	Count (%)	Factors	Count (%)
MedicalConstipation=1	2246(72.69)	MedicalConstipation=1	2795 (59.42)	MedicalConstipation=1	2160(51.47)
Sleep=1	958(31.00)	Sleep=1	1656 (35.20)	Sleep=1	1631(38.86)
MotorFunction=1	527(17.06)	MotorFunction=1	1221 (25.96)	MotorFunction=1	1473(35.10)
Gender=2	120(3.88)	MasticatoryFunction=1	666 (14.16)	MasticatoryFunction=1	982(23.40)
		Gender=2	151(3.21)	Gender=2	425(10.13)
Fold 2					
60-80 (1281)		80-90 (6344)		90+ (3039)	
Factors	Count (%)	Factors	Count (%)	Factors	Count (%)
MedicalConstipation=1	789(61.59)	MotorFunction=1	2759 (43.49)	Sleep=1	1565(51.50)
Sleep=1	601(46.92)	MedicalConstipation=1	2642 (41.65)	MedicalConstipation=1	1546(50.87)
MotorFunction=1	511(39.89)	Sleep=1	1240(19.55)	MotorFunction=1	910(29.94)
Gender=2	10(0.78)	MasticatoryFunction=1	1047 (16.50)	MasticatoryFunction=1	602(19.81)
		Gender=2	739(11.65)	Gender=2	353(11.62)
Fold 3					
60-80 (1358)		80-90 (6240)		90+ (3188)	
Factors	Count (%)	Factors	Count (%)	Factors	Count (%)
MedicalConstipation=1	1070(78.79)	MedicalConstipation=1	2763(44.28)	MedicalConstipation=1	1887(59.19)
Sleep=1	402(29.60)	Sleep=1	2490(39.90)	Sleep=1	1404(44.04)
MotorFunction=1	391(28.79)	MotorFunction=1	1908(30.58)	MotorFunction=1	900(28.23)
Gender=2	19(1.4)	MasticatoryFunction=1	872(13.97)	MasticatoryFunction=1	549(17.22)
		Gender=2	591(9.47)	Gender=2	274(8.59)

Table 4: The top five most frequently occurring factors for the healthy condition, categorized by age subgroup.

Fold 1					
60-80(3148)		80-90(3380)		90+(3923)	
Factors	Count (%)	Factors	Count (%)	Factors	Count (%)
Sleep=0	2369(75.25)	MotorFunction=0	3380(100.00)	MotorFunction=0	1994(100.00)
MotorFunction=0	2026(64.36)	MasticatoryFunction=0	1454(43.02)	Sleep=0	1121(56.22)
MedicalConstipation=0	1274(40.47)	Sleep=0	1273(37.66)	MasticatoryFunction=0	808(40.52)
EducationLevel=3	1118(35.51)	MedicalConstipation=0	1261(37.31)	MedicalConstipation=0	613(30.74)
MasticatoryFunction=0	827(26.27)				
Fold 2					
60-80(2797)		80-90(3353)		90+(3293)	
Factors	Count (%)	Factors	Count (%)	Factors	Count (%)
Sleep=0	2127(76.05)	MotorFunction=0	3353(100.00)	MotorFunction=0	3293(100.00)
MotorFunction=0	1823(65.18)	MasticatoryFunction=0	1405(41.90)	Sleep=0	1351(41.03)
MedicalConstipation=0	1238(44.26)	Sleep=0	1295(38.62)	MasticatoryFunction=0	1282(38.93)
EducationLevel=3	946(33.82)	MedicalConstipation=0	1247(37.19)	MedicalConstipation=0	1190(36.14)
MasticatoryFunction=0	732(26.17)				
Fold 3					
60-80(2684)		80-90(2813)		90+(3363)	
Factors	Count (%)	Factors	Count (%)	Factors	Count (%)
Sleep=0	2022(75.34)	MotorFunction=0	2813(100.00)	MotorFunction=0	3363(100.00)
MotorFunction=0	1777(66.21)	MasticatoryFunction=0	1388(49.34)	Sleep=0	1351(40.17)
MedicalConstipation=0	1235(46.01)	Sleep=0	1047(37.22)	MasticatoryFunction=0	1308(38.89)
EducationLevel=4	905(33.72)	MedicalConstipation=0	970(34.48)	MedicalConstipation=0	1196(35.56)
MasticatoryFunction=0	689(25.67)				