

Supplementary Material for the Article

Migrant Health Inequalities or Unequal Measurements? Testing for Cross-cultural and Longitudinal Measurement Invariance of Subjective Physical and Mental Health

Table 1 Wording and scales of SF-12

Item	Scale	SF-12 component
How would you describe your current health	very good, good, satisfactory, poor, bad	Physical (Item 1)
German: Wie würden Sie Ihren gegenwärtigen Gesundheitszustand beschreiben?	Sehr gut, gut, zufriedenstellend, weniger gut, schlecht	
When you have to climb several flights of stairs on foot, does your health limit you greatly, somewhat or not at all	greatly, somewhat, not at all	Physical (Item 2)
Wenn Sie Treppen steigen müssen, also mehrere Stockwerke zu Fuß hochgehen: Beeinträchtigt Sie dabei Ihr Gesundheitszustand stark, ein wenig oder gar nicht?	Stark, ein wenig, gar nicht	
What about other demanding everyday activities, such as when you have to lift something heavy or do something requiring physical mobility: Does your health limit you greatly, somewhat or not at all	greatly, somewhat, not at all	Physical (Item 3)
Und wie ist das mit anderen anstrengenden Tätigkeiten im Alltag, wo man z.B. etwas Schweres heben muss oder Beweglichkeit braucht: Beeinträchtigt Sie dabei Ihr Gesundheitszustand stark, ein wenig oder gar nicht	Stark, ein wenig, gar nicht	



Item	Scale	SF-12 component
During the last four weeks how often did you...		
Bitte denken Sie einmal an die letzten vier Wochen. Wie oft kam es in dieser Zeit vor, ...		
have severe physical pain	always, often, sometimes, almost never, never	Physical (Item 4)
dass Sie starke körperliche Schmerzen hatten	Immer, Oft, Manchmal, Fast nie, nie	
feel that due to physical health problems you achieved less than you wanted to at work or every-day activities	always, often, sometimes, almost never, never	Physical (Item 5)
dass Sie wegen gesundheitlicher Probleme körperlicher Art in Ihrer Arbeit oder Ihren alltäglichen Beschäftigungen weniger geschafft haben als Sie eigentlich wollten	Immer, Oft, Manchmal, Fast nie, nie	
feel that due to physical health problems you you were limited in some way at work or in every-day activities	always, often, sometimes, almost never, never	Physical (Item 6)
dass Sie wegen gesundheitlicher Probleme körperlicher Art in Ihrer Arbeit oder Ihren alltäglichen Beschäftigungen in der Art Ihrer Tätigkeiten eingeschränkt waren	Immer, Oft, Manchmal, Fast nie, nie	
During the last four weeks how often did you ...		
Bitte denken Sie einmal an die letzten vier Wochen. Wie oft kam es in dieser Zeit vor, ...		
limit social contacts due to health	always, often, sometimes, almost never, never	Mental (Item 7)
dass Sie wegen gesundheitlicher oder seelischer Probleme in Ihren sozialen Kontakten, z.B. mit Freunden, Bekannten oder Verwandten eingeschränkt waren?	Immer, Oft, Manchmal, Fast nie, nie	

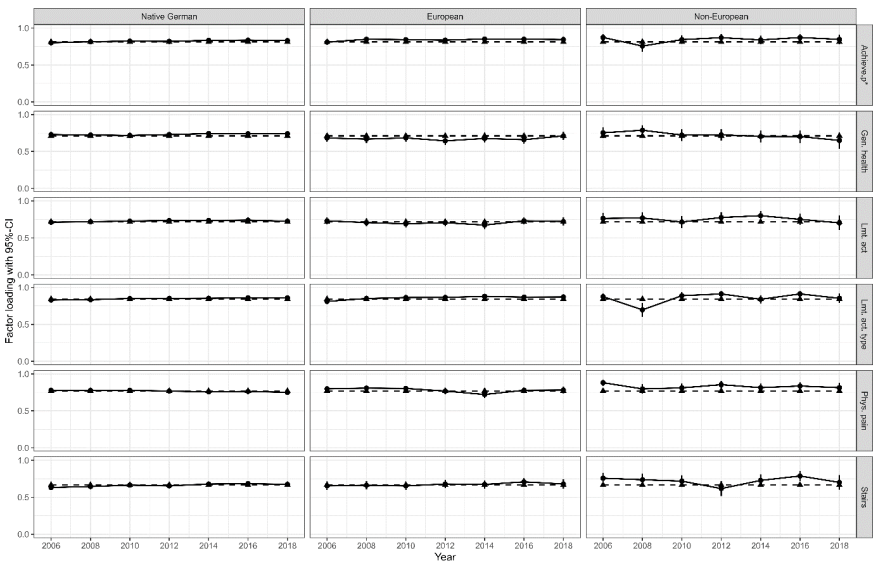
Item	Scale	SF-12 component
feel down and gloomy	always, often, sometimes, almost never, never	Mental (Item 8)
dass Sie sich niedergeschlagen und trübsinnig fühlten	Immer, Oft, Manchmal, Fast nie, nie	
feel calm and relaxed	always, often, sometimes, almost never, never	Mental (Item 9)
dass Sie sich ruhig und ausgeglichen fühlten	Immer, Oft, Manchmal, Fast nie, nie	
feel energetic	always, often, sometimes, almost never, never	Mental (Item 10)
dass Sie jede Menge Energie verspürten	Immer, Oft, Manchmal, Fast nie, nie	
feel you achieved less than you wanted to at work or in everyday activities	always, often, sometimes, almost never, never	Mental (Item 11)
dass Sie wegen seelischer oder emotionaler Probleme in Ihrer Arbeiten oder Ihren alltäglichen Beschäftigungen weniger geschafft haben als Sie eigentlich wollten?	Immer, Oft, Manchmal, Fast nie, nie	
feel you carried out your work or everyday tasks less thoroughly than usual	always, often, sometimes, almost never, never	Mental (Item 12)
dass Sie wegen seelischer oder emotionaler Probleme in Ihrer Arbeiten oder Ihren alltäglichen Beschäftigungen Ihrer Arbeit oder Tätigkeit weniger sorgfältig als sonst gemacht haben?	Immer, Oft, Manchmal, Fast nie, nie	

Note to Statistical Analysis – Error Correlations

In the physical health construct we include additional error correlations for Item 2 (health affects ascending stairs) and Item 3 (health affects tiring tasks) due to the use of a 3-point scale. A second one is included for Item 5 (achieved less due to physical health) and Item 6 (limited in some way due to physical health) due to the emphasis of “feelings” in the question wording and the separated, highlighted presentation of these items. A third error correlation includes Item 2 and Item 6. We assume that the vague and general formulation of Item 6 of having problems in “everyday activities” includes tasks as formulated in Item 2, namely ascending stairs. Also, Item 2 appears chronologically before Item 6 in the questionnaire, leaving room to assume that when reading Item 6, Item 2 is used as context information in the survey response process. In the mental health construct we additionally include error correlations for Item 11 (achieved less due to mental health) and Item 12 (carried out tasks less thoroughly due to mental health) for the same formal reasons as for the error correlation of Item 5 and Item 6. Error correlations for Item 8 (feeling down and gloomy) and Item 9 (feeling calm and relaxed), as well as between Item 9 and Item 10 (feeling energetic) are included due to the specific wording focused on “feelings”.

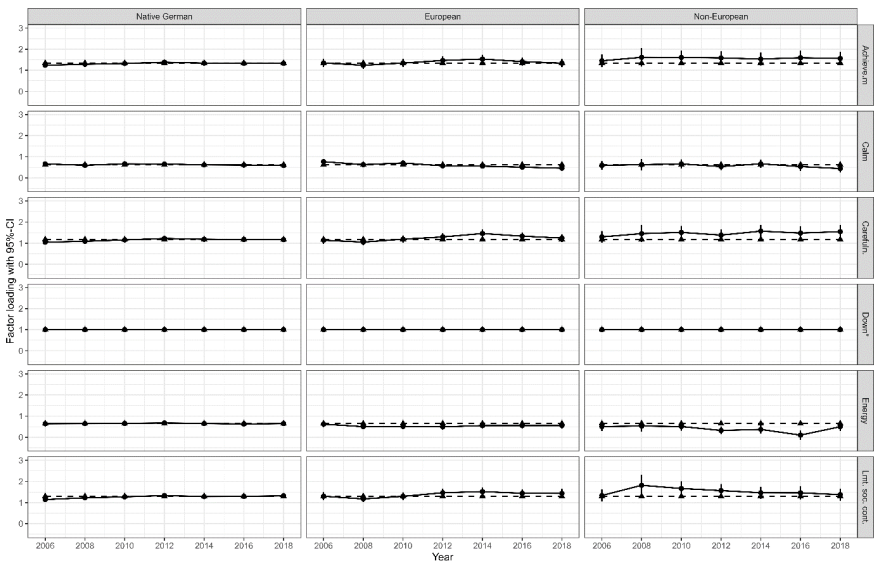
Table 2 Descriptive statistics of the initial wave sample (year 2006)

Variable	Native German (n=8247) Mean (sd)	European (n=485) Mean (sd)	Non-European (n=164) Mean (sd)	Response Scale
<i>Physical health</i>				
Item 1: Current health status	3.42 (0.90)	3.45 (0.88)	3.43 (1.05)	1 – 5
Item 2: Climbing stairs	2.55 (0.62)	2.49 (0.65)	2.55 (0.63)	1 – 3
Item 3: Demanding activities	2.41 (0.68)	2.36 (0.69)	2.44 (0.70)	1 – 3
Item 4: Physical pain	3.98 (1.07)	3.81 (1.11)	3.83 (1.21)	1 – 5
Item 5: Achieved less due to physical health	3.98 (1.05)	3.99 (1.05)	4.04 (1.07)	1 – 5
Item 6: Limited in type of activity due to physical health	4.06 (1.05)	4.01 (1.08)	4.11 (0.99)	1 – 5
<i>Mental health</i>				
Item 7: Limited social contacts due to health	4.38 (0.90)	4.37 (0.94)	4.29 (0.98)	1 – 5
Item 8: Feeling down	3.61 (0.98)	3.51 (1.01)	3.51 (1.09)	1 – 5
Item 9: Feel calm and relaxed	3.48 (0.87)	3.52 (0.92)	3.35 (0.88)	1 – 5
Item 10: Feel energetic	3.16 (0.87)	3.20 (0.89)	3.24 (0.98)	1 – 5
Item 11: Achieved less due to mental health	4.26 (0.94)	4.28 (0.94)	4.20 (1.02)	1 – 5
Item 12: Less carefulness due to mental health	4.39 (0.83)	4.42 (0.82)	4.27 (0.97)	1 – 5
<i>Sociodemographics</i>				
Age	49.6 (14.79)	49.5 (14.51)	44.1 (12.87)	-
<i>Gender % (absolute)</i>				
Female	53.0 (4380)	57.4 (278)	50.6 (83)	-
Male	47.0 (3883)	42.6 (206)	49.4 (81)	-



Note: Achieve.p*= achieved less due to physical health; Gen.health= General health status; Lmt.act.= limited amount of activities due to physical health, Lmt.act.type= limited in type of activities due to physical health, Phys.pain= Physical pain; Stairs.= problems going up stairs due to physical health;
*Reference Indicator with factor loading set to 1.00; See Supplementary Material Table 1 for wording and scales. Model 0: no constraints, Model 4: Full Invariance Model

Figure 1 Standardized Factor loadings of physical health over time (Model 0 = solid line, Model 4 = dashed line)



Note: Achieve.m= achieved less due to mental health; Calm= felt calm; Carefuln.= work less thoroughly, Down*= felt down, Energy= felt energetic; Lmt.soc.cont.= limite social contacts due to mental health;
*Reference Indicator with factor loading set to 1.00; See Supplementary Material Table 1 for wording and scales Model 0: no constraints, Model 4: Full Invariance Model

Figure 2 Standardized Factor loadings of mental health over time (Model 0 = solid line, Model 4 = dashed line)

Note: Robustness Checks – WLSMV Model Identification strategy

We specified the model the following way, adapting approaches by Liu et al. (2017).

- Metric invariance steps identical to invariance steps from prior models
- Variance of latent factors is set to 1 across all groups in the first measurement occasion (2006)
- Covariances of latent factor are estimated freely
- Indicator intercepts are set to 0 across all groups and measurement occasions
- Indicator variances are set to 1 across all groups and measurement occasions
- Diachronic within-indicator error covariances are estimated freely
- The 6 additional between-indicator error covariances are set equal across all groups and measurement occasions per indicator
- Model 0: all indicator thresholds are estimated freely across all groups and measurement occasions
- Model 2: indicator thresholds are set equal across groups but not across measurement occasions
- Model 4: indicator thresholds are set equal across groups and measurement occasions
- Model 6: indicator thresholds are set equal across measurement occasions but not across groups
- Model 7: indicator thresholds are set equal across groups but not across measurement occasions

Table 3 Fit Measures of WLSMV estimation

Model	Metric MG Invar.	Th. MG. Invar.	Metric Longit. Invar.	Th. Longit. Invar.	Latent Means	Chisq	df	CFI	RMSEA (95%-CI)	SRMR
<i>Testing for measurement invariance</i>										
0						74884.44	9177	0.994	0.049 (0.049-0.049)	0.050
1	x					77216.06	9317	0.993	0.05 (0.049-0.05)	0.050
2	x	x				78133.38	9765	0.993	0.049 (0.048-0.049)	0.050
3	x	x	x			83690.71	9825	0.993	0.05 (0.05-0.051)	0.052
4	x	x	x	x		90427.16	10017	0.992	0.052 (0.052-0.052)	0.052
<i>Calculation of latent means in different invariance settings</i>										
5	x	x	x	x	x	78161.15	10477	0.998	0.047 (0.047-0.048)	0.045
6	x		x	x	x	77860.29	10413	0.998	0.047 (0.047-0.048)	0.045
7	x	x	x		x	75855.97	10285	0.999	0.047 (0.047-0.047)	0.045

Note: 'x' in each row indicates which parameters were restricted to be equal and if latent means were calculated.
MG.: Multigroup, Longit.: Longitudinal; Invar. : Invariance, Th.: Threshold of parameterized scales, Chisq: Chi-Square test value, df: degrees of freedom, RMSEA: Root Mean Square Error of Approximation, SRMR: Standardized Root Mean Squared Error, CFI: Comparative Fit Index.

Table 4 Scaled Fit Measures of WLSMV estimation

Model	Metric MG Invar.	Th. MG. Invar.	Metric Longit. Invar.	Th. Longit. Invar.	Latent Means	Chisq	df	CFI	RMSEA (95%-CI)	Scaling factor
<i>Testing for measurement invariance</i>										
0						43842.63	9177	0.970	0.036 (0.035-0.036)	2.030
1	x					33368.93	9317	0.979	0.029 (0.029-0.03)	2.974
2	x	x				32556.77	9765	0.980	0.028 (0.028-0.028)	3.160
3	x	x	x			33879.44	9825	0.979	0.029 (0.028-0.029)	3.209
4	x	x	x	x		36300.92	10017	0.977	0.03 (0.029-0.03)	3.189
<i>Calculation of latent means in different invariance settings</i>										
5	x	x	x	x	x	33154.14	10477	0.996	0.027 (0.027-0.028)	3.139
6	x		x	x	x	33214.54	10413	0.996	0.028 (0.027-0.028)	3.112
7	x	x	x		x	32094.76	10285	0.996	0.027 (0.027-0.027)	3.162

Note: 'x' in each row indicates which parameters were restricted to be equal and if latent means were calculated.
MG.: Multigroup, Longit.: Longitudinal; Invar. : Invariance, Th.: Threshold of parameterized scales, Chisq: Chi-Square test value, df: degrees of freedom, RMSEA: Root Mean Square Error of Approximation, SRMR: Standardized Root Mean Squared Error, CFI: Comparative Fit Index;

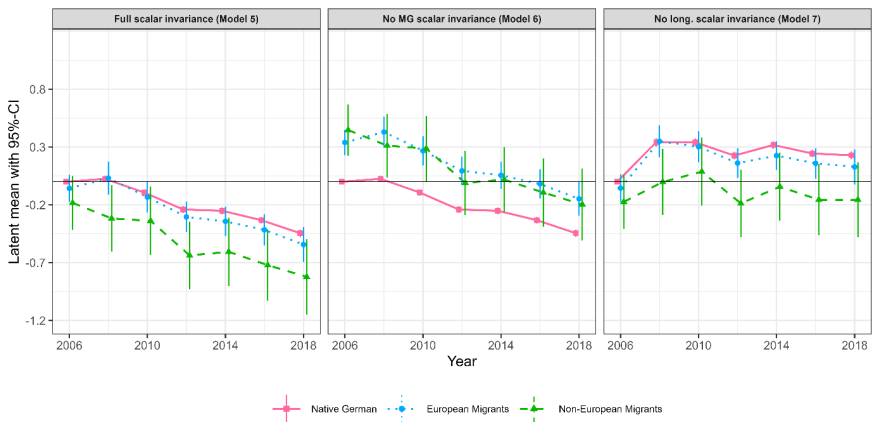


Figure 3 Latent means of physical health by scalar/threshold invariance restrictions – WLSMV estimation

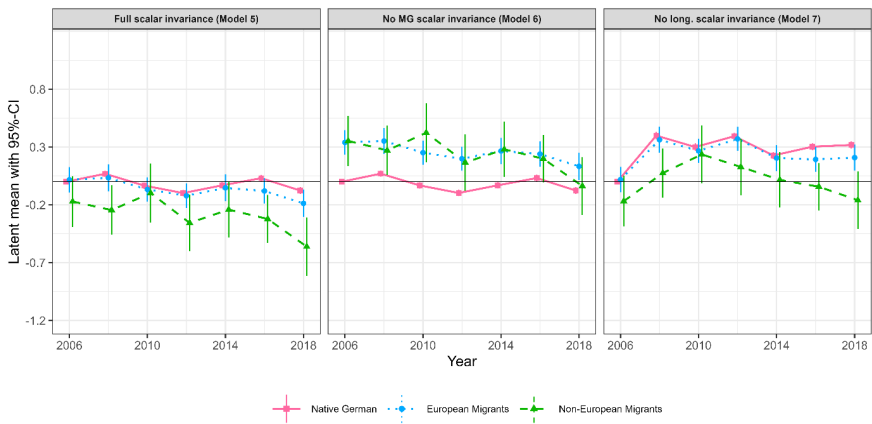


Figure 4 Latent means of mental health by scalar/threshold invariance restrictions – WLSMV estimation

Table 5 Fit Measures Robust Maximum Likelihood estimation (MLR) – Only Model 5 (Full Invariance)

Measure	Value
Robust CFI	0.946
Robust TLI	0.941
Robust RMSEA	0.033
SRMR	0.059
p-value	0.000
AIC	911701.601
Sample-size adjusted BIC	917081.511

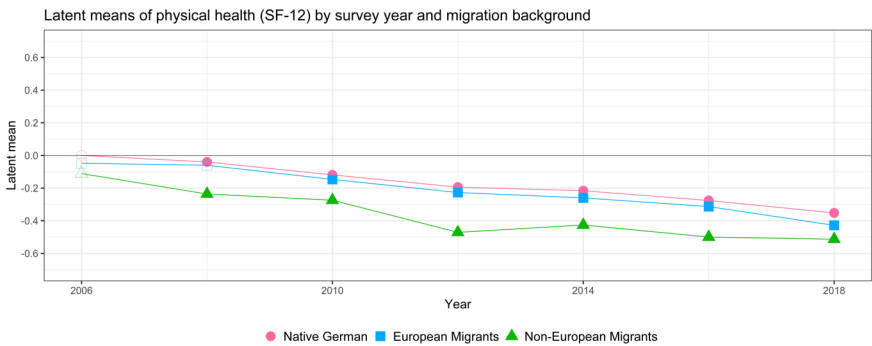


Figure 5 Latent Means of physical health - Robust estimation (MLR) Full Scalar Invariance (Model 5) only

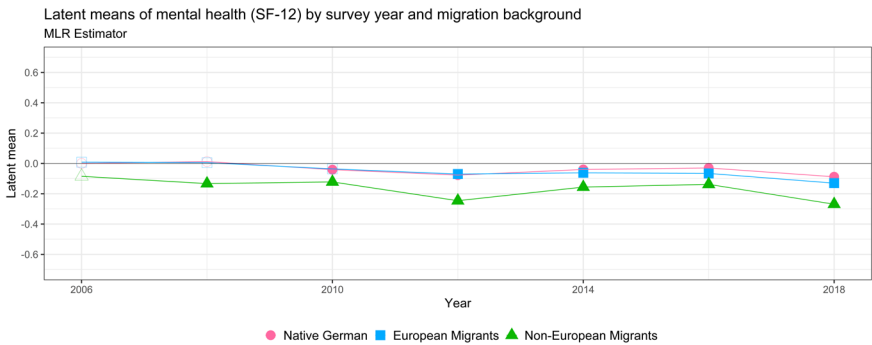


Figure 6 Latent Means of mental health - Robust estimation (MLR) Full Scalar Invariance (Model 5) only