

```
2559 0 OUTPUT ACTIVATE TLIOutput.  
2559 0 M> OUTPUT ACTIVATE TLIOutput.  
2560 0 TITLE 'Tucker-Lewis Index'.  
2560 0 M> TITLE 'Tucker-Lewis Index'.
```

Tucker-Lewis Index

```

2561 0
2561 0 M>
2562 0 GET DATA
2562 0 M> GET DATA
2563 0 /TYPE=TXT /FILE='D:\DATA ANALYSIS\L Validity Factor Analysis and Scale Testing\TLI\dataset.csv' /ENCODING='UTF8' /DELCA=
      LINE /DELIMITERS=', ' /QUALIFIER='"'
2563 0 M> /TYPE=TXT /FILE='D:\DATA ANALYSIS\L Validity Factor Analysis and Scale Testing\TLI\dataset.csv' /ENCODING='UTF8' /DELCA=
      SE=LINE /DELIMITERS=', ' /QUALIFIER='"'
2564 0 /ARRANGEMENT=DELIMITED /FIRSTCASE=2
2564 0 M> /ARRANGEMENT=DELIMITED /FIRSTCASE=2
2565 0 /VARIABLES=
2565 0 M> /VARIABLES=
2566 0 school A8 sex A8 age F8.0 address A8 famsize A8 Pstatus A8 Medu F8.0
      Fedu F8.0
2566 0 M> school A8 sex A8 age F8.0 address A8 famsize A8 Pstatus A8 Medu F
      8.0 Fedu F8.0
2567 0 Mjob A16 Fjob A16 reason A16 guardian A16 traveltime F8.0 studytime
      F8.0 failures F8.0
2567 0 M> Mjob A16 Fjob A16 reason A16 guardian A16 traveltime F8.0 studyti
      me F8.0 failures F8.0
2568 0 schoolsup A8 famsup A8 paid A8 activities A8 nursery A8 higher A8 in
      ternet A8 romantic A8
2568 0 M> schoolsup A8 famsup A8 paid A8 activities A8 nursery A8 higher A8
      internet A8 romantic A8
2569 0 famrel F8.0 freetime F8.0 goout F8.0 Dalc F8.0 Walc F8.0 health F8.0
      absences F8.0 G1 F8.0 G2 F8.0 G3 F8.0.
2569 0 M> famrel F8.0 freetime F8.0 goout F8.0 Dalc F8.0 Walc F8.0 health F
      8.0 absences F8.0 G1 F8.0 G2 F8.0 G3 F8.0.
2570 0 DATASET NAME TLIData.
2570 0 M> DATASET NAME TLIData.
2571 0 COMPUTE subject_id=$CASENUM.
2571 0 M> COMPUTE subject_id=$CASENUM.
2572 0 COMPUTE Dalc_R=6-Dalc.
2572 0 M> COMPUTE Dalc_R=6-Dalc.
2573 0 COMPUTE Walc_R=6-Walc.
2573 0 M> COMPUTE Walc_R=6-Walc.

```

Tucker-Lewis Index

```
2574 0 RECODE schoolsup famsup paid activities higher internet ('no'=0) ('yes'=1)
2574 0 M> RECODE schoolsup famsup paid activities higher internet ('no'=0) ('yes'=1)
2575 0 INTO schoolsup_b famsup_b paid_b activities_b higher_b internet_b.
2575 0 M> INTO schoolsup_b famsup_b paid_b activities_b higher_b internet_b
.
2576 0 EXECUTE.
2576 0 M> EXECUTE.
2577 0
2577 0 M>
2578 0 * BEGIN METHOD-SPECIFIC SPSS WORKFLOW.
2578 0 M> * BEGIN METHOD-SPECIFIC SPSS WORKFLOW.
2579 0 TITLE 'Tucker Lewis Index'.
2579 0 M> TITLE 'Tucker Lewis Index'.
```

Tucker Lewis Index

```
2580 0 SUBTITLE 'Parsimony-sensitive chi-square-per-df comparison'.  
2580 0 M> SUBTITLE 'Parsimony-sensitive chi-square-per-df comparison'.
```

Tucker Lewis Index
Parsimony-sensitive chi-square-per-df comparison

```

2581  0  FACTOR /VARIABLES=G1 G2 G3 famrel freetime goout /MISSING=LISTWISE /A
NALYSIS=G1 G2 G3 famrel freetime goout
2581  0 M>  FACTOR /VARIABLES=G1 G2 G3 famrel freetime goout /MISSING=LISTWISE
 /ANALYSIS=G1 G2 G3 famrel freetime goout
2582  0  /PRINT=INITIAL EXTRACTION KMO CORRELATION /PLOT=EIGEN
2582  0 M>  /PRINT=INITIAL EXTRACTION KMO CORRELATION /PLOT=EIGEN
2583  0  /CRITERIA=FACTORS(2) ITERATE(500) /EXTRACTION=PAF /ROTATION=NOROTATE
 /METHOD=CORRELATION.
2583  0 M>  /CRITERIA=FACTORS(2) ITERATE(500) /EXTRACTION=PAF /ROTATION=NOROT
ATE /METHOD=CORRELATION.

```

Factor Analysis

Notes

Output Created		18-JUL-2026 10:58:11
Comments		
Input	Data	D:\DATA ANALYSIS\L Validity Factor Analysis and Scale Testing\TLI\dataset.csv
	Active Dataset	TLIData
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	649
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.

Tucker Lewis Index
Parsimony-sensitive chi-square-per-df comparison

Notes

Syntax		FACTOR /VARIABLES=G1 G2 G3 famrel freetime goout /MISSING=LISTWISE /ANALYSIS=G1 G2 G3 famrel freetime goout /PRINT=INITIAL EXTRACTION KMO CORRELATION /PLOT=EIGEN /CRITERIA=FACTORS(2) ITERATE(500) /EXTRACTION=PAF /ROTATION=NOROTATE /METHOD=CORRELATIO N.
Resources	Processor Time	00:00:00.39
	Elapsed Time	00:00:00.29
	Maximum Memory Required	5704 (5.570K) bytes

[TLIData]

Correlation Matrix

		G1	G2	G3	famrel	freetime	goout
Correlation	G1	1.000	.865	.826	.049	-.094	-.074
	G2	.865	1.000	.919	.090	-.107	-.079
	G3	.826	.919	1.000	.063	-.123	-.088
	famrel	.049	.090	.063	1.000	.129	.090
	freetime	-.094	-.107	-.123	.129	1.000	.346
	goout	-.074	-.079	-.088	.090	.346	1.000

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.732
Bartlett's Test of Sphericity	Approx. Chi-Square	2220.632
	df	15
	Sig.	.000

Tucker Lewis Index
Parsimony-sensitive chi-square-per-df comparison

Communalities

	Initial	Extraction
G1	.755	.775
G2	.880	.966
G3	.849	.878
famrel	.034	.045
freetime	.140	.474
goout	.125	.252

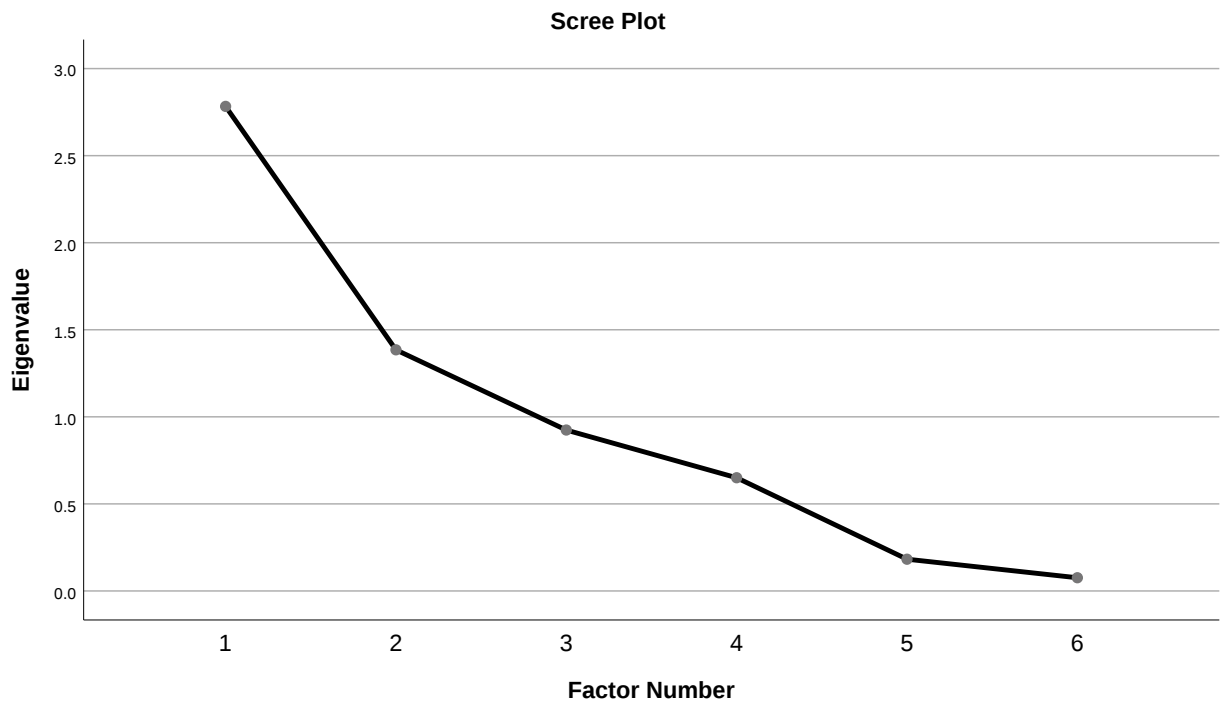
Extraction Method: Principal Axis Factoring.

Total Variance Explained

Factor	Total	Initial Eigenvalues		Extraction Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.783	46.381	46.381	2.650	44.166	44.166
2	1.385	23.080	69.461	.740	12.337	56.503
3	.924	15.402	84.863			
4	.650	10.835	95.698			
5	.182	3.038	98.736			
6	.076	1.264	100.000			

Extraction Method: Principal Axis Factoring.

Tucker Lewis Index
Parsimony-sensitive chi-square-per-df comparison



Factor Matrix^a

	Factor	
	1	2
G1	.879	.053
G2	.980	.070
G3	.936	.033
famrel	.061	.204
freetime	-.153	.671
goout	-.114	.489

Extraction Method: Principal Axis Factoring.

a. 2 factors extracted. 41 iterations required.

```
2584 0 RELIABILITY /VARIABLES=G1 G2 G3 /SCALE('Academic measurement block')
ALL /MODEL=ALPHA /STATISTICS=DESCRIPTIVE SCALE CORR.
2584 0 M> RELIABILITY /VARIABLES=G1 G2 G3 /SCALE('Academic measurement block
') ALL /MODEL=ALPHA /STATISTICS=DESCRIPTIVE SCALE CORR
```

Tucker Lewis Index
Parsimony-sensitive chi-square-per-df comparison

Reliability

Notes

Output Created		18-JUL-2026 10:58:12
Comments		
Input	Data	D:\DATA ANALYSIS\L Validity Factor Analysis and Scale Testing\TLI\dataset.csv
	Active Dataset	TLIData
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	649
	Matrix Input	D:\DATA ANALYSIS\L Validity Factor Analysis and Scale Testing\TLI\tli_spss_synta x.sps
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=G1 G2 G3 /SCALE('Academic measurement block') ALL /MODEL=ALPHA /STATISTICS=DESCRIPT IVE SCALE CORR.
Resources	Processor Time	00:00:00.05
	Elapsed Time	00:00:00.04

Scale: Academic measurement block

Tucker Lewis Index
Parsimony-sensitive chi-square-per-df comparison

Case Processing Summary

		N	%
Cases	Valid	649	100.0
	Excluded ^a	0	.0
	Total	649	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.951	.953	3

Item Statistics

	Mean	Std. Deviation	N
G1	11.40	2.745	649
G2	11.57	2.914	649
G3	11.91	3.231	649

Inter-Item Correlation Matrix

	G1	G2	G3
G1	1.000	.865	.826
G2	.865	1.000	.919
G3	.826	.919	1.000

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
34.88	72.251	8.500	3

```
2585 0 RELIABILITY /VARIABLES=famrel freetime goout /SCALE('Social measureme
nt block') ALL /MODEL=ALPHA /STATISTICS=DESCRIPTIVE SC
ALE CORR.
```

Tucker Lewis Index
Parsimony-sensitive chi-square-per-df comparison

```
2585  0 M> RELIABILITY /VARIABLES=famrel freetime goout /SCALE('Social measur
ement block') ALL /MODEL=ALPHA /STATISTICS=DESCRIPTIVE
SCALE CORR.
```

Reliability

Notes

Output Created		18-JUL-2026 10:58:12
Comments		
Input	Data	D:\DATA ANALYSIS\L Validity Factor Analysis and Scale Testing\TL\dataset.csv
	Active Dataset	TLIData
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	649
	Matrix Input	D:\DATA ANALYSIS\L Validity Factor Analysis and Scale Testing\TL\ltli_spss_synta x.sps
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=famrel freetime goout /SCALE ('Social measurement block') ALL /MODEL=ALPHA /STATISTICS=DESCRIPT IVE SCALE CORR.
Resources	Processor Time	00:00:00.05
	Elapsed Time	00:00:00.03

Tucker Lewis Index
Parsimony-sensitive chi-square-per-df comparison

Scale: Social measurement block

Case Processing Summary

		N	%
Cases	Valid	649	100.0
	Excluded ^a	0	.0
	Total	649	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.419	.411	3

Item Statistics

	Mean	Std. Deviation	N
famrel	3.93	.956	649
freetime	3.18	1.051	649
goout	3.18	1.176	649

Inter-Item Correlation Matrix

	famrel	freetime	goout
famrel	1.000	.129	.090
freetime	.129	1.000	.346
goout	.090	.346	1.000

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
10.30	4.718	2.172	3

2586 0 ECHO 'TLI explicitly compares target and baseline chi-square per df'.

Tucker Lewis Index
Parsimony-sensitive chi-square-per-df comparison

```

2586  0 M> ECHO 'TLI explicitly compares target and baseline chi-square per d
f'.
TLI explicitly compares target and baseline chi-square per df
2587  0 * END METHOD-SPECIFIC SPSS WORKFLOW.
2587  0 M> * END METHOD-SPECIFIC SPSS WORKFLOW.
2588  0
2588  0 M>
2589  0 SAVE OUTFILE='D:\DATA ANALYSIS\L Validity Factor Analysis and Scale T
esting\TLI\SPSS_Output\sav\tli_spss_ready_data.sav' /C
OMPRESSED.
2589  0 M> SAVE OUTFILE='D:\DATA ANALYSIS\L Validity Factor Analysis and Scal
e Testing\TLI\SPSS_Output\sav\tli_spss_ready_data.sav'
/COMPRESSED.

2590  0
2590  0 M>
2591  0 ECHO '=====
====='.
2591  0 M> ECHO '=====
====='.
=====

2592  0 ECHO 'TUCKER-LEWIS INDEX'.
2592  0 M> ECHO 'TUCKER-LEWIS INDEX'.
TUCKER-LEWIS INDEX
2593  0 ECHO 'Design: Parsimony-sensitive incremental fit using target and ba
seline chi-square per degree of freedom.'.
2593  0 M> ECHO 'Design: Parsimony-sensitive incremental fit using target and
baseline chi-square per degree of freedom.'.
Design: Parsimony-sensitive incremental fit using target and baseline chi-squa
re per degree of freedom.
2594  0 ECHO 'Null hypothesis: The target model does not improve chi-square p
er df relative to independence.'.
2594  0 M> ECHO 'Null hypothesis: The target model does not improve chi-squar
e per df relative to independence.'.
Null hypothesis: The target model does not improve chi-square per df relative
to independence.
2595  0 ECHO 'Formula:  $TLI = (chi2\_b/df\_b - chi2\_t/df\_t) / (chi2\_b/df\_b - 1)$ '.
2595  0 M> ECHO 'Formula:  $TLI = (chi2\_b/df\_b - chi2\_t/df\_t) / (chi2\_b/df\_b - 1)$ '.
Formula:  $TLI = (chi2\_b/df\_b - chi2\_t/df\_t) / (chi2\_b/df\_b - 1)$ .
2596  0 ECHO 'Variables: G1, G2, G3, famrel, freetime, goout'.

```

Tucker Lewis Index
Parsimony-sensitive chi-square-per-df comparison

```
2596  0 M> ECHO 'Variables: G1, G2, G3, famrel, freetime, goout'.
Variables: G1, G2, G3, famrel, freetime, goout
2597  0 ECHO 'Rows analyzed: 649'.
2597  0 M> ECHO 'Rows analyzed: 649'.
Rows analyzed: 649
2598  0 ECHO 'baseline_chi_square_per_df = 148.69226231469202'.
2598  0 M> ECHO 'baseline_chi_square_per_df = 148.69226231469202'.
baseline_chi_square_per_df = 148.69226231469202
2599  0 ECHO 'baseline_df = 15'.
2599  0 M> ECHO 'baseline_df = 15'.
baseline_df = 15
2600  0 ECHO 'target_chi_square_per_df = 1.7204965096422775'.
2600  0 M> ECHO 'target_chi_square_per_df = 1.7204965096422775'.
target_chi_square_per_df = 1.7204965096422775
2601  0 ECHO 'target_df = 8'.
2601  0 M> ECHO 'target_df = 8'.
target_df = 8
2602  0 ECHO 'tli = 0.9951216367171145'.
2602  0 M> ECHO 'tli = 0.9951216367171145'.
tli = 0.9951216367171145
2603  0 ECHO 'Cross-check status: pass'.
2603  0 M> ECHO 'Cross-check status: pass'.
Cross-check status: pass
2604  0 ECHO '=====
====='.
2604  0 M> ECHO '=====
====='.
=====
2605  0
2605  0 M>
2606  0 OUTPUT SAVE OUTFILE='D:\DATA ANALYSIS\L Validity Factor Analysis and
Scale Testing\TLI\SPSS_Output\spv\tli_spss_output.spv'
.
2606  0 M> OUTPUT SAVE OUTFILE='D:\DATA ANALYSIS\L Validity Factor Analysis a
nd Scale Testing\TLI\SPSS_Output\spv\tli_spss_output.s
pv'.
2607  0 OUTPUT EXPORT /CONTENTS EXPORT=ALL LAYERS=PRINTSETTING MODELVIEWS=PRI
NTSETTING
```

Tucker Lewis Index
Parsimony-sensitive chi-square-per-df comparison

2607 0 M> OUTPUT EXPORT /CONTENTS EXPORT=ALL LAYERS=PRINTSETTING MODELVIEWS=
PRINTSETTING