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Invariance of Measures to Understand Decision-Making for Pursuing Living Donor Kidney Transplant

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Abstract

Living donor kidney transplant is the ideal treatment option for end-stage renal disease; however, the decision to pursue living donor kidney transplant is complex and challenging. Measurement invariance of living donor kidney transplant Decisional Balance and Self-Efficacy across gender (male/female), race (Black/White), and education level (no college/college or higher) were examined using a sequential approach. Full strict invariance was found for Decisional Balance and Self-Efficacy for gender and partial strict invariance was found for Decisional Balance and Self-Efficacy across race and education level. This information will inform tailored feedback based on these constructs in future intervention studies targeting behavior change among specific demographic subgroups.

Keywords

behavioral medicine; ethnicity; health behavior; inequalities; kidney; methodology; organ transplantation; quantitative methods; race

Introduction

Chronic kidney disease (CKD) is a condition that can lead to complete or near-complete kidney failure. CKD is diagnosed in approximately 13.6% of adults in the United States (U.S. Renal Data System, 2014: 12). Patients whose kidneys fail, a stage of CKD called end-stage renal disease (ESRD), must start dialysis, a process where a machine filters their blood weekly to remove impurities, or receive a deceased or living donor kidney transplant (LDKT). Dialysis is the most common treatment for ESRD, with approximately 402,500 patients undergoing dialysis treatment in the United States in 2012, (U.S. Renal Data System, 2014: 105). Deceased donor kidney transplantation (DDKT) and LDKT are the optimal alternatives to kidney dialysis, having been shown to help restore some ESRD patients to better health, often helping them to resume full social and occupational functioning (Neipp et al., 2006; Wolf et al., 1999). Most importantly, patients who receive a

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LDKT have the best outcomes, with survival rates at one, five, and 10 years post-transplantation being substantially higher than DDKT recipients (U.S. Renal Data System, 2014: 159). In addition, LDKT patients typically have improved quality of life in comparison to DDKT patients (De Groot et al., 2013), though all recipients may need long-term support to experience well-being comparable to healthy controls (Gremigni & Cappelli, 2014).

Despite the advantages of LDKT over dialysis and DDKT, patients are less likely to pursue this treatment option. In fact, data from the 2012 Organ Procurement and Transplantation Network Annual Data Report (OPTN/SRTR) on kidney donation indicate that LDKTs have decreased over recent years, while DDKTs have increased slightly since 2005 (Matas et al., 2014). Further, racial minorities (Waterman et al., 2010, 2013), women (Jindal et al., 2005), and patients with lower levels of education are less likely to receive transplants, particularly LDKTs (Epstein et al., 2000). Thus, educational and behavioral health interventions are needed to ensure full evaluation of LDKT as a treatment option and support ESRD patients of all racial/ethnic backgrounds, genders, and educational levels through a high quality transplant decision-making process (Marlow et al., 2014).

Interventions that target the process of LDKT decision-making need psychometrically sound measures that are effective and generalizable to patients from different backgrounds. A strong theoretical framework, such as the Transtheoretical Model (TTM) of behavior change, should be used to guide measures. The TTM has been applied to the decision making process in organ donation and transplantation including clarifying the decision processes for families considering donating a loved one’s organs (Robbins et al., 2001) and deciding to be organ and tissue donors after death (Hall et al., 2007). More recently, Waterman et al. (2010) developed TTM measures for kidney patients considering the pursuit of a deceased donor kidney transplant.

Briefly, the TTM is a model of planned behavior change that consists of three core constructs representing different aspects of change: Stage of Change (SOC), which measures the change in motivation for specific behaviors through time (Prochaska and DiClemente, 1983), Decisional Balance (DB), which assesses how an individual weighs the Pros and Cons of behavior change (Velicer et al., 1985), and Self-Efficacy (SE), which demonstrates whether an individual believes they can engage in or sustain a behavior change during difficult situations (Bandura, 1977). Though educational interventions to increase patient motivation to pursue LDKT exist, Waterman et al. (2015) presents the development of the first theoretically consistent and validated TTM measures to assess the motivation of kidney patients to pursue LDKT. Further psychometric analysis, such as testing measurement invariance, could support the use of these measures across important demographic subgroups to assist clinicians in understanding all their patients’ LDKT decision-making.

Current study

In order to accurately study intervention effects across individuals with different demographic characteristics, items in a measurement model need to have equivalent meaning for all subgroups. In other words, researchers need to establish that questions on a scale are measuring the same construct in the same way regardless of the respondent’s demographic characteristics. This is especially important in the context of tailored interventions, where an intervention found to be effective in the general population is then applied to target specific demographic subgroups (e.g., minority groups). The current study evaluates the measurement invariance of the measurement structure for two TTM constructs (DB and SE) for LDKT decision making developed by Waterman et al. (2015) across gender (male/female), race (Black/White), and education level (no college/college degree or higher).

Invariance testing is a powerful method for assessing whether an underlying construct has the same meaning across groups and thus allows for valid and meaningful group comparison (Dimitrov, 2010). However, until invariance has been established, discrepancies observed in constructs among groups should never be assumed to be due to group membership alone (Wu, Li and Zumbo, 2007). Invariance has previously been examined in TTM measures including: Temptations to Try Alcohol (Harrington, Babbin and Velicer, 2011), DB for alcohol (Babbin, Harrington and Velicer, 2011), and Temptations to Try Smoking (McGee et al., 2012). The current study is the first to focus on establishing invariance of EB and DB measures for pursuing LDKT.

Method

Sample

Kidney patients (N=483) at various stages of the transplant evaluation process at Barnes-Jewish Hospital Transplant Center and three St. Louis dialysis centers were contacted by telephone and enrolled in the study. Patients were eligible to be included if they were 18 years or older, English speaking, could hear and cognitively understand the consent, had not received a previous kidney transplant or were told they were ineligible to receive a transplant. The recruitment procedure was designed to oversample for minority patients and to include patients at all levels of readiness to pursue LDKT. All recruitment and survey procedures were approved by the Internal Review Board (#09-1294) at Washington University School of Medicine in St. Louis, MO. Further, participation by dialysis patients was approved by Medical Directors and dialysis center Clinical Research Departments. See Waterman et al. (2015) for a detailed description of the sample and recruitment and Waterman et al. (2014) for a description of study protocol.

Measures

Demographic Subgroups—Gender (male, n=272; female, n=211), race (non-Hispanic Black, n=200; non-Hispanic White, n=272), and education level were assessed using single items. For the current study, eleven participants who reported race/ethnicity to be other than Black/White or did not report race were excluded from analyses. Participants ranged in age from 21 to 83, with a mean age of 54 (SD=12). Due to the insufficient sample size for participants in some education groups (e.g., only nine participants reported less than a high school degree), education level was categorized into two groups, “no college degree” (n=215) or “college degree or higher” (n=268).

Stage of Change—Stage of Change (SOC) was assessed to determine an individual's readiness to take actions towards obtaining a LDKT. After being presented with a list of seven LDKT actions (e.g., accept someone's offer to be a living donor, share need for living donor with large community), participants were asked to choose one of the four following statements to characterize their readiness: *Precontemplation* (not considering taking actions in the next six months to pursue living donation); *Contemplation* (considering taking actions in the next six months to pursue living donation); *Preparation* (preparing to take actions in the next 30 days to pursue living donation); *Action* (taking actions to pursue living donation). See Waterman et al. (2015) for a complete description of the staging algorithm and for a description of the seven LDKT actions.

Decisional Balance—See Table 1 for a complete list of items. A correlated two-factor DB measure (Pros coefficient alpha=0.86 and Cons coefficient alpha=0.80) was used to assess the Pros and Cons of pursuing LDKT (Waterman et al., 2015). The measure contained 12 items with six items for each factor measuring the positive and negative outcomes associated with LDKT. Patients were asked to rate on a 5-point scale (i.e. "How important is this statement to your decision about living donor transplant: I will feel guilty having someone donate to me?" ranging from, "Not important" [1] to "Extremely important" [5]).

Situational Self–efficacy—See Table 1 for a complete list of items. A six-item single factor SE measure (coefficient alpha=0.876) was used to assess the confidence a patient has to pursue LDKT through a variety of difficult situations (Waterman et al., 2015). Patients were asked to rate on a 5-point scale (i.e. "How confident are you that you could get a living donor transplant?" ranging from "not at all confident" [1] to "completely confident" [5]).

Analysis

Investigation of measurement invariance is done sequentially using multiple-group confirmatory factor analysis (CFA) and is assessed by four increasingly constrained nested models (Dimitrov, 2010; Meredith and Teresi, 2006; Wu, Li and Zumbo, 2007). This approach begins with *configural* invariance, in which all parameters are freely estimated across groups. The configural step determines whether groups demonstrate the same factor structure and, therefore, the same general latent construct. If configural invariance does not hold, further examination of invariance is not warranted because the same items do not load on the same factors in each group. Next, *metric* invariance (also called pattern or weak invariance) is established by constraining factor loadings across groups. Metric invariance assures that the items are relating the same factors consistently. Then, *scalar* invariance is considered by constraining equal intercepts and factor loadings across groups. This step assures that participants in different groups on average rate the items similarly. Finally, *strict* invariance is supported when equal error variances are constrained in addition to equal intercepts and factor loadings. Testing residual error establishes that the same amount of error, or variance not accounted by the factor, is consistent for each item across groups.

Analyses were conducted using SPSS version 22 and Mplus Version 7 using robust maximum likelihood estimation (Muthén and Muthén, 2012). Two measures, DB and SE for pursuing LDKT, were assessed for invariance across gender (male/female), race (Black/

White), and education (no college degree/college degree or higher). Model fit was evaluated for each step of invariance by comparing increasingly constrained nested models using the loglikelihood (-2LL) rescaled difference test (Satorra, 2000). The Comparative Fit Index (CFI) and Root Mean Square Error of Approximation (RMSEA) were also used to assess model fit. CFI values of greater than 0.90 indicate good fit and values greater than 0.95 are ideal (Bentler, 1992; Kline, 2011). Values less than 0.10 for the RMSEA indicate good fit and values less than 0.05 indicate very good fit (Browne and Cudeck, 1993; Kline, 2011). Although invariance is frequently assessed using difference tests of nested models, results are supplemented by an examination of the change in CFI (ΔCFI) between levels of invariance as a robust test of between-group invariance. Difference values greater than -0.01 for the CFI represent support for invariance beyond the previous (i.e. less constrained) model (Cheoung and Rensvold, 2002).

Results

SOC distributions by demographic subgroup are displayed in Supplementary Table 1. Chi-squared tests demonstrated no significant differences in stage distribution for gender or education level, but were significant for race, $\chi^2(3)=9.530$, $p=0.023$ suggesting that Black participants were more likely to be in pre-action stages for pursuit of LDKT. Descriptive statistics for the DB and SE measures are displayed for gender, race/ethnicity, and education level in Supplementary Table 2. Stepwise evaluation of model fit and comparisons for DB and SE is presented in Tables 2 and 3, respectively. Supplementary Table 3 presents sample size and Cronbach's alpha for measures by demographic subgroup.

Decisional Balance

Strict measurement invariance was found with good model fit for gender (CFI=0.950; RMSEA=.042) and partial strict invariance was found for race (CFI=0.952; RMSEA=0.044) and education level (CFI=0.956; RMSEA=0.041). Internal validity was very good, with Cronbach's alpha reliability of .0848 and 0.787 for Pros and Cons subscales, respectively.

Partial strict invariance was achieved for race and education level after freeing constraints for one item. For nested model comparisons across race, invariance at the scalar level failed the scaled difference test (Model 3a) and came very close to failing the ΔCFI test. Modification indices suggested freeing item five from the pros scale ("My living donor will feel good seeing my health improve"), resulting in a model (Model 3b) that fit significantly better than the full scalar model, $-2LL(1)=8.692$, $p=0.003$. Thus, the intercept for this item was allowed to be freely estimated across groups for all subsequent models, resulting in partial invariance at the strict level (Model 4) and signifying that all residual errors were equivalent.

Similarly, for education level comparisons, partial strict invariance was achieved after invariance at the scalar level failed the scaled difference test (Model 3a) and the ΔCFI exceeded the -0.01 cutoff value. Modification indices suggested freeing the intercept of item five from the pros scale ("My living donor will feel good seeing my health improve"), which resulted in a model (Model 3b) with significantly better fit than the full scalar model, $-2LL(1)=19.200$, $p<0.001$. As with race comparisons, the intercept for this item was allowed to be freely estimated across groups for all subsequent models. However, partial invariance at the strict level holding this intercept free failed the scaled difference test (Model 4a) and the ΔCFI test. Modification indices suggested freeing the residual variance of item five of the pros, resulting in a significantly better fitting model than the previous model, $-2LL(1)=15.248$, $p<0.001$. The final model (Model 4b) passed the scaled difference test and the ΔCFI test.

Self-Efficacy

Strict measurement invariance was found for SE for gender (CFI=0.949; RMSEA=0.077) and partial strict invariance was found for race (CFI=0.941; RMSEA=0.086) and education level (CFI=0.951; RMSEA=0.078). The overall scale had excellent reliability, with a Cronbach's alpha of 0.902.

Partial strict invariance was achieved for race and education level after freeing constraints for two items. For nested model comparisons across race, invariance at the scalar level failed the scaled difference test (Model 3b) and ΔCFI test. Modification indices suggested freeing the intercept for item five ("A potential living donor who was evaluated did not match you?"), resulting in a model (Model 3b) that fit significantly better than the full scalar model, $-2LL(1)=22.034$, $p<0.001$, but still failed the scaled difference comparison with the metric model. However, it did not fail the ΔCFI test and no modification indices suggested modifications, so the intercept for this item was allowed to be freely estimated across groups and further constrained models were examined. Partial invariance at the strict level failed the scaled difference test (Model 4a) but not the ΔCFI test. Modification indices suggested freeing the residual for item five, resulting in a significantly better fitting model, $-2LL(1)=3.829$, p=0.05l. The final model (Model 4b) demonstrating partial strict invariance passed the scaled difference test and the ΔCFI test.

For education level comparisons, invariance at the scalar level failed the scaled difference test (Model 3a) and was at the threshold for failure of the ΔCFI test. Modification indices suggested freeing the intercept for item six ("Other people were not supportive of you having a living donor transplant?"), resulting in a model (Model 3b) that fit significantly better than the full scalar model, $-2LL(1)=6.156$, $p=0.012$. Thus, the intercept for this item was allowed to be freely estimated across groups for all subsequent models. Partial invariance at the strict level (Model 4) was supported by the scaled difference test, signifying that all residual errors were equivalent.

Discussion

While LDKT is the treatment of choice for ESRD patients, pursuing and obtaining a living donor kidney requires that patients have significant cognitive, emotional and social resources to navigate the decision process. To reduce known racial and socioeconomic disparities in access to LDKT, the development of culturally sensitive behavioral and educational interventions are needed. In addition, validated measures that are relevant and consistent across patient groups are necessary to assess the efficacy of the proposed interventions. The finding that the distribution of SOC did not vary by gender or education level, but did vary across race/ethnicity group is consistent with the goals of LDKT interventions (Waterman et al., 2015, 2014) in facilitating readiness to change for LDKT in minority groups.

Overall, the measures demonstrated good model fit and all the scales showed excellent internal reliability for use with patients of varying levels of gender, race, and education. At minimum, all measures demonstrated full metric invariance, indicating that factor structure and loadings were equivalent across all groups, providing strong evidence for the hypothesized factor structure and item loadings for the DB and SE measures developed by Waterman et al. (2015). Further, by establishing invariance at the strict level for gender comparisons, this study has shown that the DB and SE constructs have equivalent factor loading patterns, intercepts, and error variances for men and women. Establishment of partial strict measurement invariance of DB and SE scales for race and education level comparisons revealed that the intercepts and residual errors for some items were not invariant across groups. These differences may due to sample fluctuation but this information should serve to enlighten future interventions, as researchers need to be sensitive to potential mean differences in these items for specific groups. For example, Black participants and participants with less than a college degree rated item five from the Pros subscale ("My living donor will feel good seeing my health improve") as more important in their decision to pursue LDKT than White participants and participants with a college degree or higher. In addition, for the SE scale, Black participants rated their confidence they could pursue LDKT for item five ("A potential living donor who was evaluated did not match you?") lower than White participants. Previous research comparing White and Black families' attitudes about organ donation suggests that these racial disparities may be partially due to discrimination within health care systems. Siminoff, Lawrence and Arnold (2003) identified specific limitations that may contribute to the lower rates of Black organ donors (as compared to Whites), which include fewer opportunities to speak with health care providers or organ procurement organization staff regarding organ donation options, and less favorable attitudes toward organ donation and the health care system. Race differences observed in the above items may reflect decreased confidence in the health care system, thus future research should be sensitive to the potential for lower confidence in Blacks.

Similarly, participants with less than a college degree rated item six from the SE scale ("Other people were not supportive of you having a living donor transplant?") lower than participants with a college degree or higher. This finding suggests that participants with lower educational attainment may perceive decreased social support as a greater barrier to pursuing LDKT than those with higher educational attainment. This association has been shown previously in a sample of kidney transplant recipients, in which lower socioeconomic status (SES) and the absence of a romantic partner significantly predicted depression symptoms (Szeifert et al., 2010). Further, social support is significantly associated with health outcomes in several chronic illnesses, including ERSD (Patel, Peterson and Kimmel, 2008) suggesting that researchers and health care providers address social support issues, particularly in lower SES patients, to increase willingness to pursue LDKT.

For some models, residual error terms were found to be different across groups. This indicates that the portion of error in items not accounted for by a construct may not be equivalent between groups. However, many researchers argue that invariance at the strict level is not a requirement for the establishment of measurement invariance because it imposes extremely rigorous constraints on a model that has already demonstrated impressive equivalency (Little, 1997; Vandenberg and Vance, 2000). Regardless, future studies may want to be sensitive to the potential for this discrepancy, as this could indicate a portion of unique variance unaccounted for by the construct not considered by the study rather than just random noise.

The findings of the current study are especially relevant to research focusing on minority health issues, as many measures are validated with samples that do not reflect a minority population. This study promotes the need to test potential measurement discrepancies in these populations and given the history of disparity, is especially relevant to understanding and supporting decision-making for patients pursuing LDKT. The establishment of measurement invariance indicates that constructs are being measured similarly across demographic groups, thereby providing empirical and psychometric support for their use with those groups in applied settings. Investigators that utilize these TTM measures can have increased confidence that the scales are relevant for Black and White participants, men and women and across educational levels. Tailored interventions to support the LDKT decision process can utilize these measures in efforts to better understand and reduce disparities in kidney transplant. Mean differences on the scales or possibly key items can be used to tailor the intervention messaging and resources, for example, by giving normative feedback to Black participants that lower pros and efficacy to pursue LDKT are consistent with kidney patients like them. Intervention efforts can target key subgroups to enhance participation in the process of pursuing LDKT, with efforts to increase the pros that have the greatest variance by that demographic.

It should be noted that due to the nature of measurement invariance testing and sample size constraints within this study, participants were grouped into dichotomous demographic levels, though the levels in this study may not be the best representation of homogenous subgrouping. For example, the study was designed to compare measures in Black and White samples and thus does not include measurement representative of other minority groups and sample size does not permit for acknowledgement of heterogeneity within racial subgroups. Similarly, education level was dichotomized at the college level, which may not be optimal for comparison of measurement. Comparison of individuals with and without a high school degree may be a more meaningful comparison of education level. These are limitations that could be addressed in a larger, more diverse study.

The current study bolsters confidence that the DB and SE scales for pursuing LDKT reflect the same constructs in ESRD patients regardless of gender, race and educational level, with some differences in intercept and residual error levels for a small number of items. These differences do not affect the pattern of loadings on constructs but may reflect lower confidence and favorable attitudes (i.e. Pros) toward LDKT in some groups with a history of disparities. Establishment of the equivalency of these measures supports their validity and reliability across important ESRD demographic groups, strengthening future research and intervention efforts in health disparities.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Description of items for DB and SE measures

Scale	Item	Item Description
DB: Pros	PRO1	A living donor transplant can happen more quickly because I don't have to wait for a kidney from the waiting list
	PRO2	A living donor kidney generally lasts longer than a deceased donor kidney
	PRO3	With a living donor transplant I can return to my normal activities sooner
	PRO4	I will be healthier because I spent less time on dialysis
	PRO5	My living donor will feel good seeing my health improve
	PRO6	With a living donor transplant I will be able to contribute to my family and friends sooner
DB: Cons	CON1	I will feel guilty having someone donate to me
	CON2	I don't want to involve anyone else in my health problems
	CON3	A living donor could have health problems due to donating
	CON4	Donation could harm my relationship with a living donor
	CON5	The surgery will inconvenience the living donors work or life too much
	CON6	The living donor could not donate again if someone closer to them ever needed a kidney
SE	SE1	You don't know anyone who might be a living donor for you?
	SE2	You didn't know how to discuss living donation with potential donors?
	SE3	You asked someone to donate and they turned you down?
	SE4	A potential living donor changed their mind and decided not to be evaluated?
	SE5	A potential living donor who was evaluated did not match you?
	SE6	Other people were not supportive of you having a living donor transplant?

Note: DB = Decisional Balance; SE = Self-Efficacy; PRO = Pros subscale of DB; CON = Cons subscale of DB.

Table 2

Model fit and nested model comparisons for Decisional Balance scale by subgroup

Subgroup	Model	Model H0 LL	H0 LL Scale Factor	# Free Param	Scaled Diff in -2LL	DF	P	CFI	ΔCFI	RMSEA
Gender	1. Configural Model	-8465.642	1.373	74	--	--	--	0.959	--	0.046
	2. Metric	-8470.245	1.404	64	7.838	10	0.645	0.960	0.001	0.043
	3. Scalar	-8476.718	1.475	54	12.706	10	0.241	0.958	-0.002	0.043
	4. Strict	-8492.816	1.351	42	16.867	12	0.155	0.950	-0.008	0.042
Race	1. Configural Model	-8267.563	1.407	74	--	--	--	0.952	--	0.050
	2. Metric	-8276.138	1.441	64	14.424	10	0.155	0.948	-0.004	0.049
	3a. Scalar	-8286.730	1.518	54	20.759	10	**0.023**	0.940	-0.008	0.051
	3b. Scalar (with PRO5 intercept free)	-8282.139	1.510	55	11.807	9	0.224	0.946	-0.002	0.049
	4. Strict Invariance (with PRO5 intercept free)	-8292.788	1.341	43	10.059	12	0.611	0.952	0.006	0.044
Education	1. Configural Model	-8415.105	1.454	74	--	--	--	0.963	--	0.043
	2. Metric	-8422.457	1.487	64	11.863	10	0.294	0.962	-0.001	0.042
	3a. Scalar	-8436.448	1.586	54	29.252	10	**0.001**	0.948	**-0.014**	0.046
	3b. Scalar (with PRO5 intercept free)	-8430.142	1.569	55	15.526	9	0.077	0.957	-0.005	0.043
	4a. Strict (with PRO5 intercept free)	-8477.878	1.346	43	40.320	12	**0.000**	0.917	**-0.040**	0.056
	4b. Strict (with PRO5 intercept and residual free)	-8444.873	1.414	44	13.455	11	0.265	0.956	-0.001	0.041

Note: bold typeface indicates violation of invariance; Model H0 LL = Null Model Log Liklihood; H0 LL Scale Factor = Scale Factor for Null Model; # Free Param = Number of free parameters in the model; Scaled Diff in -2LL = Scaled Differece for the -2 Log Liklihood; DF = Degrees of freedom; P = Exact p-value; CFI = Comparative Fit Index; **Δ**CFI = Change in Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation

Table 3

Model fit and nested model comparisons for Self-Efficacy scale by subgroup

Subgroup	Model	Model H0 LL	H0 LL Scale Factor	# Free Param	Scaled Diff in -2LL	DF	P	CFI	ΔCFI	RMSEA
Gender	1. Configural Model	-4029.026	1.282	36	--	--	--	0.948	--	0.107
	2. Metric	-4032.012	1.327	31	5.977	5	0.308	0.943	-0.005	0.100
	3. Scalar	-4034.355	1.392	26	4.716	5	0.451	0.939	-0.004	0.093
	4. Strict	-4036.947	1.210	20	2.597	6	0.857	0.949	0.010	0.077
Race	1. Configural Model	-3921.562	1.276	36	--	--	--	0.954	--	0.101
	2. Metric	-3924.109	1.321	31	5.104	5	0.403	0.950	-0.004	0.093
	3a. Scalar	-3938.666	1.388	26	29.979	5	**0.000**	0.928	**-0.022**	0.101
	3b. Scalar (with SE5 intercept free)	-3928.969	1.369	27	9.780	4	**0.044**	0.943	-0.007	0.092
	4a. Strict (with SE5 intercept free)	-3942.526	1.184	21	13.437	6	**0.037**	0.937	-0.006	0.088
	4b. Strict (with SE5 intercept and residual free)	-3937.274	1.255	22	8.869	5	0.114	0.941	-0.002	0.086
Education	1. Configural Model	-4026.639	1.272	36	--	--	--	0.951	--	0.104
	2. Metric	-4027.966	1.316	31	2.644	5	0.755	0.948	-0.003	0.095
	3a. Scalar	-4035.499	1.374	26	14.881	5	**0.011**	0.938	**-0.010**	0.094
	3b. Scalar (with SE6 free)	-4032.421	1.359	27	8.707	4	0.069	0.942	-0.006	0.092
	4. Strict (with SE6 intercept free)	-4034.008	1.205	22	1.558	5	0.906	0.951	0.009	0.078

Note: bold typeface indicates violation of invariance; Model H0 LL = Null Model Log Liklihood; H0 LL Scale Factor = Scale Factor for Null Model; # Free Param = Number of free parameters in the model; Scaled Diff in -2LL = Scaled Differece for the -2 Log Liklihood; DF = Degrees of freedom; P = Exact p-value; CFI = Comparative Fit Index; **Δ**CFI = Change in Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation;