

Simulation Results

Simulation Results

Negatively Skewed Distributions

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Positively Skewed Distributions

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Table S1*Raw biases of the observed mean difference estimates*

C	n_k	p_{ni}	d_{ni}	$\alpha_f = 0$	$\alpha_f = 0.2$	$\alpha_f = 0.5$
2	100	0		0.00	0.00	0.00
			Small	0.00	0.00	0.00
		1	Large	-0.01	-0.01	-0.01
			Small	-0.01	-0.01	-0.01
		3	Large	-0.02	-0.02	-0.02
	200	0		0.00	0.00	0.00
			Small	0.00	0.00	0.00
		1	Large	-0.01	-0.01	-0.01
			Small	-0.01	-0.01	-0.01
		3	Large	-0.02	-0.02	-0.02
	500	0		0.00	0.00	0.00
			Small	0.00	0.00	0.00
		1	Large	-0.01	-0.01	-0.01
			Small	-0.01	-0.01	-0.01
		3	Large	-0.02	-0.02	-0.02

Note. C = number of response categories. n_k = group size. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean difference.

Table S2*Raw biases of the observed mean difference estimates (Cont.)*

C	n_k	p_{ni}	d_{ni}	$\alpha_f = 0$	$\alpha_f = 0.2$	$\alpha_f = 0.5$
5	100	0		0.00	0.00	0.00
			Small	-0.01	-0.01	-0.01
		1	Large	-0.02	-0.02	-0.02
			Small	-0.03	-0.03	-0.03
		3	Large	-0.05	-0.06	-0.06
	200	0		0.00	0.00	0.00
			Small	-0.01	-0.01	-0.01
		1	Large	-0.02	-0.02	-0.02
			Small	-0.03	-0.03	-0.03
		3	Large	-0.05	-0.06	-0.06
	500	0		0.00	0.00	0.00
			Small	-0.01	-0.01	-0.01
		1	Large	-0.02	-0.02	-0.02
			Small	-0.03	-0.03	-0.03
		3	Large	-0.05	-0.06	-0.06

Note. C = number of response categories. n_k = group size. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean difference.

Table S3*Raw biases of the observed mean difference estimates (Cont.)*

C	n_k	p_{ni}	d_{ni}	$\alpha_f = 0$	$\alpha_f = 0.2$	$\alpha_f = 0.5$
7	100	0		0.00	0.00	0.00
			Small	-0.01	-0.01	-0.01
		1	Large	-0.02	-0.02	-0.02
			Small	-0.03	-0.03	-0.04
		3	Large	-0.06	-0.07	-0.07
	200	0		0.00	0.00	0.00
			Small	-0.01	-0.01	-0.01
		1	Large	-0.02	-0.02	-0.02
			Small	-0.03	-0.03	-0.03
		3	Large	-0.06	-0.06	-0.07
	500	0		0.00	0.00	0.00
			Small	-0.01	-0.01	-0.01
		1	Large	-0.02	-0.02	-0.02
			Small	-0.03	-0.03	-0.03
		3	Large	-0.06	-0.07	-0.07

Note. C = number of response categories. n_k = group size. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean difference.

Table S4*Raw biases and standard errors of the factor mean differences*

<i>C</i>	<i>n_k</i>	<i>p_{ni}</i>	<i>d_{ni}</i>	$\alpha_f = 0$				$\alpha_f = 0.2$				$\alpha_f = 0.5$			
				Scalar		Str./P. Str.		Scalar		Str./P. Str.		Scalar		Str./P. Str.	
				Bias	SE	Bias	SE	Bias	SE	Bias	SE	Bias	SE	Bias	SE
2	100	0		2.95	4.13	0.01	0.17	2.21	4.58	0.01	0.18	1.4	4.90	0.01	0.21
			Small	1.85	3.86	0	0.18	1.58	3.61	0	0.19	1.05	4.11	0.01	0.21
		1	Large	1.96	3.79	0	0.18	1.58	3.91	0	0.19	0.99	3.83	0	0.21
			Small	2.1	3.77	0	0.19	2.34	4.22	0	0.20	1.09	3.72	0	0.23
		3	Large	1.75	3.53	0	0.19	1.47	3.66	-0.01	0.20	1.4	3.66	0	0.23
	200	0		1.54	3.67	0	0.12	1.13	3.48	0	0.13	1.14	4.07	0	0.14
			Small	1.86	3.81	0.01	0.13	1.58	4.03	0.01	0.13	0.98	4.51	0.01	0.15
		1	Large	1.91	3.52	0.01	0.13	1.19	3.67	0.01	0.13	0.99	4.09	0.01	0.15
			Small	1.59	3.26	0	0.13	1.53	3.58	0	0.14	0.83	3.63	0	0.16
		3	Large	1.55	2.80	0	0.13	1.57	3.13	0	0.14	0.51	2.83	0	0.16
	500	0		1.78	3.73	0	0.08	1.25	3.68	0	0.08	0.85	4.31	0	0.09
			Small	1.73	3.57	0	0.08	1.44	3.65	0	0.08	0.84	3.83	0	0.09
		1	Large	1.81	3.40	0	0.08	1.19	3.71	0	0.08	0.66	3.69	0	0.09
			Small	1.33	3.20	0	0.08	1.29	3.62	0	0.09	0.63	3.79	0	0.10
		3	Large	1.44	3.02	0	0.08	0.98	3.19	0	0.09	0.5	3.41	0	0.10

Note.

C = number of response categories. *n_k* = group size. *p_{ni}* = number of unique factor noninvariant items. *d_{ni}* = degree of unique factor noninvariance. α_f = population factor mean difference. Scalar = scalar invariance model. Str./P. Str. = strict invariance model when *p_{ni}* = 0 or partial strict invariance model otherwise.

Table S5*Raw biases and standard errors of the factor mean differences (Cont.)*

<i>C</i>	<i>n_k</i>	<i>p_{ni}</i>	<i>d_{ni}</i>	$\alpha_f = 0$				$\alpha_f = 0.2$				$\alpha_f = 0.5$			
				Scalar		Str./P. Str.		Scalar		Str./P. Str.		Scalar		Str./P. Str.	
				Bias	SE	Bias	SE	Bias	SE	Bias	SE	Bias	SE	Bias	SE
5	100	0		0.01	0.16	0.01	0.16	0	0.17	0	0.17	-0.01	0.18	-0.02	0.18
			Small	0	0.16	0	0.16	-0.01	0.17	-0.01	0.17	-0.01	0.18	-0.02	0.18
		1	Large	0	0.16	0	0.16	-0.01	0.17	-0.01	0.17	-0.01	0.18	-0.02	0.18
			Small	0	0.16	0	0.16	0	0.17	0	0.17	-0.01	0.18	-0.02	0.18
		3	Large	0	0.17	0	0.17	0	0.17	0	0.17	-0.01	0.18	-0.02	0.18
	200	0		0	0.11	0	0.11	0	0.12	0	0.12	0	0.13	0	0.12
			Small	0	0.12	0	0.11	0	0.12	0	0.12	0	0.13	0	0.12
		1	Large	0	0.12	0	0.11	0	0.12	0	0.12	0	0.13	0	0.12
			Small	0	0.12	0	0.12	0	0.12	0	0.12	0.01	0.13	0	0.13
		3	Large	0	0.12	0	0.12	0	0.12	0	0.12	0.01	0.13	0	0.13
	500	0		0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08
			Small	0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08
		1	Large	0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08
			Small	0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08
		3	Large	0	0.07	0	0.07	0	0.08	0	0.07	0	0.08	0	0.08

Note. *C* = number of response categories. *n_k* = group size. *p_{ni}* = number of unique factor noninvariant items. *d_{ni}* = degree of unique factor noninvariance. α_f = population factor mean difference. Scalar = scalar invariance model. Str./P. Str. = strict invariance model when *p_{ni}* = 0 or partial strict invariance model otherwise.

Table S6*Raw biases and standard errors of the factor mean differences (Cont.)*

<i>C</i>	<i>n_k</i>	<i>p_{ni}</i>	<i>d_{ni}</i>	$\alpha_f = 0$				$\alpha_f = 0.2$				$\alpha_f = 0.5$			
				Scalar		Str./P. Str.		Scalar		Str./P. Str.		Scalar		Str./P. Str.	
				Bias	SE	Bias	SE	Bias	SE	Bias	SE	Bias	SE	Bias	SE
7	100	0		0	0.16	0	0.16	-0.01	0.17	-0.01	0.17	-0.01	0.18	-0.02	0.18
			Small	0	0.16	0	0.16	-0.01	0.17	-0.01	0.17	-0.02	0.18	-0.03	0.18
		1	Large	0	0.16	0	0.16	-0.01	0.17	-0.01	0.17	-0.02	0.18	-0.04	0.18
			Small	0	0.16	0	0.16	-0.01	0.17	-0.01	0.17	-0.02	0.18	-0.03	0.18
		3	Large	0	0.16	0	0.16	-0.01	0.17	-0.01	0.17	-0.01	0.18	-0.02	0.18
	200	0		0	0.11	0	0.11	0	0.12	0	0.12	0	0.12	0	0.12
			Small	0	0.11	0	0.11	0	0.12	0	0.12	0	0.12	0	0.12
		1	Large	0	0.11	0	0.11	0	0.12	0	0.12	0	0.12	0	0.12
			Small	0	0.11	0	0.11	0	0.12	0	0.12	0	0.12	0	0.12
		3	Large	0	0.12	0	0.12	0.01	0.12	0	0.12	0.01	0.13	0	0.12
	500	0		0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08
			Small	0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08
		1	Large	0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08
			Small	0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08
		3	Large	0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08

Note. *C* = number of response categories. *n_k* = group size. *p_{ni}* = number of unique factor noninvariant items. *d_{ni}* = degree of unique factor noninvariance. α_f = population factor mean difference. Scalar = scalar invariance model. Str./P. Str. = strict invariance model when *p_{ni}* = 0 or partial strict invariance model otherwise.

Table S7*Raw biases of the observed mean difference estimates*

C	n_k	p_{ni}	d_{ni}	$\alpha_f = 0$	$\alpha_f = 0.2$	$\alpha_f = 0.5$
2	100	0		0.00	0.00	0.00
			Small	0.00	0.00	0.00
		1	Large	0.00	0.00	0.00
			Small	0.01	0.01	0.00
		3	Large	0.02	0.01	0.01
	200	0		0.00	0.00	0.00
			Small	0.00	0.00	0.00
		1	Large	0.01	0.01	0.00
			Small	0.01	0.01	0.01
		3	Large	0.02	0.01	0.01
	500	0		0.00	0.00	0.00
			Small	0.00	0.00	0.00
		1	Large	0.01	0.00	0.00
			Small	0.01	0.01	0.00
		3	Large	0.02	0.01	0.01

Note. C = number of response categories. n_k = group size. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean difference.

Table S8*Raw biases of the observed mean difference estimates (Cont.)*

C	n_k	p_{ni}	d_{ni}	$\alpha_f = 0$	$\alpha_f = 0.2$	$\alpha_f = 0.5$
5	100	0		0.00	0.00	0.00
			Small	0.01	0.01	0.00
		1	Large	0.02	0.01	0.01
			Small	0.02	0.02	0.02
		3	Large	0.05	0.04	0.03
5	200	0		0.00	0.00	0.00
			Small	0.01	0.01	0.01
		1	Large	0.02	0.02	0.01
			Small	0.03	0.02	0.02
		3	Large	0.05	0.05	0.04
5	500	0		0.00	0.00	0.00
			Small	0.01	0.01	0.01
		1	Large	0.02	0.01	0.01
			Small	0.03	0.02	0.02
		3	Large	0.05	0.04	0.03

Note. C = number of response categories. n_k = group size. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean difference.

Table S9*Raw biases of the observed mean difference estimates (Cont.)*

C	n_k	p_{ni}	d_{ni}	$\alpha_f = 0$	$\alpha_f = 0.2$	$\alpha_f = 0.5$
7	100	0		0.00	0.00	0.00
			Small	0.01	0.01	0.01
		1	Large	0.02	0.02	0.01
			Small	0.04	0.03	0.02
		3	Large	0.07	0.06	0.05
	200	0		0.00	0.00	0.00
			Small	0.02	0.01	0.01
		1	Large	0.03	0.02	0.02
			Small	0.04	0.04	0.03
		3	Large	0.08	0.07	0.05
	500	0		0.00	0.00	0.00
			Small	0.01	0.01	0.01
		1	Large	0.02	0.02	0.02
			Small	0.04	0.03	0.03
		3	Large	0.07	0.07	0.05

Note. C = number of response categories. n_k = group size. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean difference.

Table S10*Raw biases and standard errors of the factor mean differences*

<i>C</i>	<i>n_k</i>	<i>p_{ni}</i>	<i>d_{ni}</i>	$\alpha_f = 0$				$\alpha_f = 0.2$				$\alpha_f = 0.5$			
				Scalar		Str./P. Str.		Scalar		Str./P. Str.		Scalar		Str./P. Str.	
				Bias	SE	Bias	SE	Bias	SE	Bias	SE	Bias	SE	Bias	SE
2	100	0		-1.87	4.19	0	0.17	-2.32	3.47	-0.01	0.17	-1.82	2.63	-0.01	0.17
			Small	-1.46	3.43	-0.01	0.18	-2.54	3.65	-0.01	0.17	-1.49	2.48	-0.01	0.17
		1	Large	-1.62	3.57	-0.01	0.18	-2.44	3.44	-0.01	0.17	-1.3	2.40	-0.01	0.17
			Small	-1.9	3.49	0	0.19	-2.26	3.39	-0.01	0.18	-1.68	2.51	-0.01	0.18
		3	Large	-1.33	3.10	0	0.19	-1.49	2.93	0	0.18	-1.32	2.22	-0.01	0.18
	200	0		-2.67	3.89	0	0.12	-1.39	3.17	0	0.12	-1.55	2.41	-0.01	0.12
			Small	-1.63	3.29	0	0.13	-1.75	2.85	0	0.12	-2.1	2.39	0	0.12
		1	Large	-1.51	3.13	0	0.13	-1.38	2.77	0	0.12	-1.64	2.16	0	0.12
			Small	-1.3	3.23	0	0.13	-1.34	2.87	0	0.13	-1.29	2.18	0	0.12
		3	Large	-1.6	3.19	0	0.13	-1.53	2.65	0	0.13	-1.37	1.98	0	0.12
	500	0		-1.72	4.00	0	0.08	-1.63	3.32	0	0.08	-1.39	2.05	0	0.08
			Small	-1.47	3.35	0	0.08	-1.5	2.96	0	0.08	-1.45	1.94	0	0.08
		1	Large	-1.45	2.95	0	0.08	-1.97	2.77	0	0.08	-1.44	1.81	0	0.08
			Small	-1.28	3.60	0	0.08	-1.46	2.64	0	0.08	-1.32	1.73	0	0.08
		3	Large	-1.44	2.86	0	0.08	-1.17	2.32	0	0.08	-1.3	1.63	0	0.08

Note. *C* = number of response categories. *n_k* = group size. *p_{ni}* = number of unique factor noninvariant items. *d_{ni}* = degree of unique factor noninvariance. α_f = population factor mean difference. Scalar = scalar invariance model. Str./P. Str. = strict invariance model when *p_{ni}* = 0 or partial strict invariance model otherwise.

Table S11*Raw biases and standard errors of the factor mean differences (Cont.)*

<i>C</i>	<i>n_k</i>	<i>p_{ni}</i>	<i>d_{ni}</i>	$\alpha_f = 0$				$\alpha_f = 0.2$				$\alpha_f = 0.5$			
				Scalar		Str./P. Str.		Scalar		Str./P. Str.		Scalar		Str./P. Str.	
				Bias	SE	Bias	SE	Bias	SE	Bias	SE	Bias	SE	Bias	SE
5	100	0		0.01	0.16	0.01	0.16	0	0.17	0	0.17	-0.01	0.18	-0.02	0.18
			Small	0	0.16	0	0.16	-0.01	0.17	-0.01	0.17	-0.01	0.18	-0.02	0.18
		1	Large	0	0.16	0	0.16	-0.01	0.17	-0.01	0.17	-0.01	0.18	-0.02	0.18
			Small	0	0.16	0	0.16	0	0.17	0	0.17	-0.01	0.18	-0.02	0.18
		3	Large	0	0.17	0	0.17	0	0.17	0	0.17	-0.01	0.18	-0.02	0.18
	200	0		0	0.11	0	0.11	0	0.12	0	0.12	0	0.13	0	0.12
			Small	0	0.12	0	0.11	0	0.12	0	0.12	0	0.13	0	0.12
		1	Large	0	0.12	0	0.11	0	0.12	0	0.12	0	0.13	0	0.12
			Small	0	0.12	0	0.12	0	0.12	0	0.12	0.01	0.13	0	0.13
		3	Large	0	0.12	0	0.12	0	0.12	0	0.12	0.01	0.13	0	0.13
	500	0		0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08
			Small	0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08
		1	Large	0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08
			Small	0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08
		3	Large	0	0.07	0	0.07	0	0.08	0	0.07	0	0.08	0	0.08

Note. *C* = number of response categories. *n_k* = group size. *p_{ni}* = number of unique factor noninvariant items. *d_{ni}* = degree of unique factor noninvariance. α_f = population factor mean difference. Scalar = scalar invariance model. Str./P. Str. = strict invariance model when *p_{ni}* = 0 or partial strict invariance model otherwise.

Table S12*Raw biases and standard errors of the factor mean differences (Cont.)*

C	n_k	p_{ni}	d_{ni}	$\alpha_f = 0$				$\alpha_f = 0.2$				$\alpha_f = 0.5$			
				Scalar		Str./P. Str.		Scalar		Str./P. Str.		Scalar		Str./P. Str.	
				Bias	SE	Bias	SE	Bias	SE	Bias	SE	Bias	SE	Bias	SE
7	100	0		0	0.16	0	0.16	-0.01	0.17	-0.01	0.17	-0.01	0.18	-0.02	0.18
			Small	0	0.16	0	0.16	-0.01	0.17	-0.01	0.17	-0.02	0.18	-0.03	0.18
		1	Large	0	0.16	0	0.16	-0.01	0.17	-0.01	0.17	-0.02	0.18	-0.04	0.18
			Small	0	0.16	0	0.16	-0.01	0.17	-0.01	0.17	-0.02	0.18	-0.03	0.18
		3	Large	0	0.16	0	0.16	-0.01	0.17	-0.01	0.17	-0.01	0.18	-0.02	0.18
	200	0		0	0.11	0	0.11	0	0.12	0	0.12	0	0.12	0	0.12
			Small	0	0.11	0	0.11	0	0.12	0	0.12	0	0.12	0	0.12
		1	Large	0	0.11	0	0.11	0	0.12	0	0.12	0	0.12	0	0.12
			Small	0	0.11	0	0.11	0	0.12	0	0.12	0	0.12	0	0.12
		3	Large	0	0.12	0	0.12	0.01	0.12	0	0.12	0.01	0.13	0	0.12
	500	0		0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08
			Small	0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08
		1	Large	0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08
			Small	0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08
		3	Large	0	0.07	0	0.07	0	0.07	0	0.07	0	0.08	0	0.08

Note. C = number of response categories. n_k = group size. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean difference. Scalar = scalar invariance model. Str./P. Str. = strict invariance model when $p_{ni} = 0$ or partial strict invariance model otherwise.

Table S13*Raw biases of the observed mean difference estimates*

C	n_k	p_{ni}	d_{ni}	$\alpha_f = 0$	$\alpha_f = 0.2$	$\alpha_f = 0.5$
2	100	0		-0.01	-0.01	-0.01
			Small	-0.02	-0.02	-0.02
		1	Large	-0.03	-0.03	-0.03
			Small	-0.04	-0.04	-0.04
		3	Large	-0.08	-0.07	-0.07
	200	0		0.00	0.00	0.00
			Small	-0.01	-0.01	-0.01
		1	Large	-0.02	-0.03	-0.03
			Small	-0.04	-0.04	-0.03
		3	Large	-0.07	-0.07	-0.07
	500	0		0.00	0.00	0.00
			Small	-0.01	-0.01	-0.01
		1	Large	-0.02	-0.03	-0.02
			Small	-0.03	-0.03	-0.03
		3	Large	-0.07	-0.07	-0.06

Note. C = number of response categories. n_k = group size. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean difference.

Table S14*Raw biases of the observed mean difference estimates (Cont.)*

C	n_k	p_{ni}	d_{ni}	$\alpha_f = 0$	$\alpha_f = 0.2$	$\alpha_f = 0.5$
5	100	0		-0.01	-0.01	-0.03
			Small	-0.01	-0.02	-0.04
		1	Large	-0.02	-0.03	-0.05
			Small	-0.01	-0.02	-0.05
		3	Large	-0.03	-0.04	-0.08
5	200	0		0.00	-0.01	-0.01
			Small	-0.01	-0.01	-0.02
		1	Large	-0.01	-0.02	-0.03
			Small	-0.02	-0.02	-0.03
		3	Large	-0.03	-0.04	-0.06
5	500	0		0.00	0.00	0.00
			Small	-0.01	-0.01	-0.01
		1	Large	-0.02	-0.02	-0.02
			Small	-0.02	-0.03	-0.03
		3	Large	-0.04	-0.05	-0.05

Note. C = number of response categories. n_k = group size. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean difference.

Table S15*Raw biases and standard errors of the factor mean differences*

<i>C</i>	<i>n_k</i>	<i>p_{ni}</i>	<i>d_{ni}</i>	$\alpha_f = 0$				$\alpha_f = 0.2$				$\alpha_f = 0.5$			
				Scalar		Str./P. Str.		Scalar		Str./P. Str.		Scalar		Str./P. Str.	
				Bias	SE	Bias	SE	Bias	SE	Bias	SE	Bias	SE	Bias	SE
2	100	0		0.51	1.20	0.03	0.27	0.73	1.94	0.07	0.32	1.37	3.15	0.12	0.43
			Small	0.45	1.09	0.05	0.29	0.71	2.01	0.09	0.36	0.83	2.91	0.12	0.45
		1	Large	0.44	1.15	0.05	0.29	0.74	1.76	0.09	0.35	0.84	2.79	0.12	0.46
			Small	0.54	1.47	0.07	0.35	1.46	2.49	0.13	0.44	1.21	3.45	0.25	0.66
		3	Large	0.92	1.74	0.07	0.35	0.9	2.48	0.13	0.44	1.32	4.16	0.24	0.65
	200	0		0.15	0.55	0.02	0.18	0.23	0.78	0.04	0.21	0.39	1.33	0.11	0.28
			Small	0.16	0.55	0.01	0.19	0.26	0.80	0.03	0.23	0.48	1.54	0.1	0.31
		1	Large	0.13	0.57	0.01	0.19	0.24	0.81	0.03	0.23	0.44	1.52	0.1	0.31
			Small	0.16	0.62	0.02	0.22	0.28	0.95	0.04	0.27	0.52	1.75	0.13	0.38
		3	Large	0.19	0.73	0.02	0.23	0.39	1.27	0.05	0.28	0.87	2.30	0.13	0.39
	500	0		0.05	0.31	0.01	0.11	0.07	0.41	0.02	0.13	0.15	0.65	0.04	0.17
			Small	0.06	0.32	0.01	0.12	0.07	0.41	0.02	0.14	0.15	0.64	0.04	0.18
		1	Large	0.05	0.32	0.01	0.12	0.07	0.41	0.02	0.14	0.15	0.65	0.04	0.18
			Small	0.05	0.34	0.01	0.14	0.08	0.45	0.02	0.16	0.2	0.78	0.05	0.22
		3	Large	0.05	0.36	0.01	0.14	0.1	0.50	0.02	0.16	0.21	0.87	0.05	0.22

Note.

C = number of response categories. *n_k* = group size. *p_{ni}* = number of unique factor noninvariant items. *d_{ni}* = degree of unique factor noninvariance. α_f = population factor mean difference. Scalar = scalar invariance model. Str./P. Str. = strict invariance model when *p_{ni}* = 0 or partial strict invariance model otherwise.

Table S16*Raw biases and standard errors of the factor mean differences (Cont.)*

<i>C</i>	<i>n_k</i>	<i>p_{ni}</i>	<i>d_{ni}</i>	$\alpha_f = 0$				$\alpha_f = 0.2$				$\alpha_f = 0.5$			
				Scalar		Str./P. Str.		Scalar		Str./P. Str.		Scalar		Str./P. Str.	
				Bias	SE	Bias	SE	Bias	SE	Bias	SE	Bias	SE	Bias	SE
5	100	0		0	0.15	0	0.15	-0.01	0.15	-0.01	0.15	-0.01	0.16	-0.01	0.16
			Small	0	0.15	0	0.15	0	0.15	0	0.15	-0.02	0.16	-0.02	0.16
		1	Large	0	0.15	0	0.15	0	0.15	-0.01	0.15	-0.01	0.16	-0.02	0.16
			Small	0.01	0.15	0.01	0.15	0	0.15	0	0.15	-0.01	0.16	-0.01	0.16
		3	Large	0	0.15	0	0.15	0.01	0.15	0.01	0.15	-0.02	0.16	-0.02	0.16
	200	0		0	0.11	0	0.11	0	0.11	0	0.11	0	0.11	0	0.11
			Small	0	0.11	0	0.11	0	0.11	0	0.11	0	0.11	0	0.11
		1	Large	0	0.11	0	0.11	0	0.11	0	0.11	0	0.11	0	0.11
			Small	0	0.11	0	0.11	0	0.11	0	0.11	-0.01	0.11	-0.01	0.11
		3	Large	0	0.11	0	0.11	0	0.11	0	0.11	0	0.11	0	0.11
	500	0		0	0.07	0	0.07	0	0.07	0	0.07	0	0.07	0	0.07
			Small	0	0.07	0	0.07	0	0.07	0	0.07	0	0.07	0	0.07
		1	Large	0	0.07	0	0.07	0	0.07	0	0.07	0	0.07	0	0.07
			Small	0	0.07	0	0.07	0	0.07	0	0.07	0	0.07	0	0.07
		3	Large	0	0.07	0	0.07	0	0.07	0	0.07	0	0.07	0	0.07

Note. *C* = number of response categories. *n_k* = group size. *p_{ni}* = number of unique factor noninvariant items. *d_{ni}* = degree of unique factor noninvariance. α_f = population factor mean difference. Scalar = scalar invariance model. Str./P. Str. = strict invariance model when *p_{ni}* = 0 or partial strict invariance model otherwise.

Table S17*Raw biases of the observed mean difference estimates*

C	n_k	p_{ni}	d_{ni}	$\alpha_f = 0$	$\alpha_f = 0.2$	$\alpha_f = 0.5$
2	100	0		0.00	0.00	0.00
			Small	0.00	0.00	0.00
		1	Large	-0.01	-0.01	-0.01
			Small	-0.01	-0.01	-0.01
		3	Large	-0.02	-0.02	-0.02
	200	0		0.00	0.00	0.00
			Small	0.00	0.00	0.00
		1	Large	-0.01	-0.01	-0.01
			Small	-0.01	-0.01	-0.01
		3	Large	-0.02	-0.02	-0.02
	500	0		0.00	0.00	0.00
			Small	0.00	0.00	0.00
		1	Large	-0.01	-0.01	-0.01
			Small	-0.01	-0.01	-0.01
		3	Large	-0.02	-0.02	-0.02

Note. C = number of response categories. n_k = group size. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean difference.

Table S18*Raw biases of the observed mean difference estimates (Cont.)*

C	n_k	p_{ni}	d_{ni}	$\alpha_f = 0$	$\alpha_f = 0.2$	$\alpha_f = 0.5$
5	100	0		0.00	0.00	0.00
			Small	-0.01	-0.01	-0.01
		1	Large	-0.02	-0.02	-0.02
			Small	-0.03	-0.03	-0.03
		3	Large	-0.06	-0.06	-0.05
	200	0		0.00	0.00	0.00
			Small	-0.01	-0.01	-0.01
		1	Large	-0.02	-0.02	-0.02
			Small	-0.03	-0.03	-0.03
		3	Large	-0.06	-0.06	-0.05
	500	0		0.00	0.00	0.00
			Small	-0.01	-0.01	-0.01
		1	Large	-0.02	-0.02	-0.02
			Small	-0.03	-0.03	-0.03
		3	Large	-0.06	-0.06	-0.05

Note. C = number of response categories. n_k = group size. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean difference.

Table S19*Raw biases of the observed mean difference estimates (Cont.)*

C	n_k	p_{ni}	d_{ni}	$\alpha_f = 0$	$\alpha_f = 0.2$	$\alpha_f = 0.5$
7	100	0		0.00	0.00	0.00
			Small	-0.02	-0.02	-0.02
		1	Large	-0.03	-0.03	-0.03
			Small	-0.05	-0.05	-0.05
		3	Large	-0.10	-0.10	-0.09
	200	0		0.00	0.00	0.00
			Small	-0.02	-0.02	-0.02
		1	Large	-0.03	-0.03	-0.03
			Small	-0.05	-0.05	-0.05
		3	Large	-0.10	-0.10	-0.09
	500	0		0.00	0.00	0.00
			Small	-0.02	-0.02	-0.02
		1	Large	-0.03	-0.03	-0.03
			Small	-0.05	-0.05	-0.04
		3	Large	-0.10	-0.10	-0.09

Note. C = number of response categories. n_k = group size. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean difference.

Table S20*Raw biases of the observed mean difference estimates*

C	n_k	p_{ni}	d_{ni}	$\alpha_f = 0$	$\alpha_f = 0.2$	$\alpha_f = 0.5$
2	2000	0		0.00	0.00	0.00
			Small	0.00	0.00	0.00
		1	Large	-0.01	-0.01	-0.01
			Small	-0.01	-0.01	-0.01
		3	Large	-0.02	-0.02	-0.02

Note. C = number of response categories. n_k = group size. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean difference.

Table S21*Raw biases of the observed mean difference estimates (Cont.)*

C	n_k	p_{ni}	d_{ni}	$\alpha_f = 0$	$\alpha_f = 0.2$	$\alpha_f = 0.5$
5	2000	0		0.00	0.00	0.00
			Small	-0.01	-0.01	-0.01
		1	Large	-0.02	-0.02	-0.02
		3	Small	-0.03	-0.03	-0.03
			Large	-0.05	-0.06	-0.06

Note. C = number of response categories. n_k = group size. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean difference.

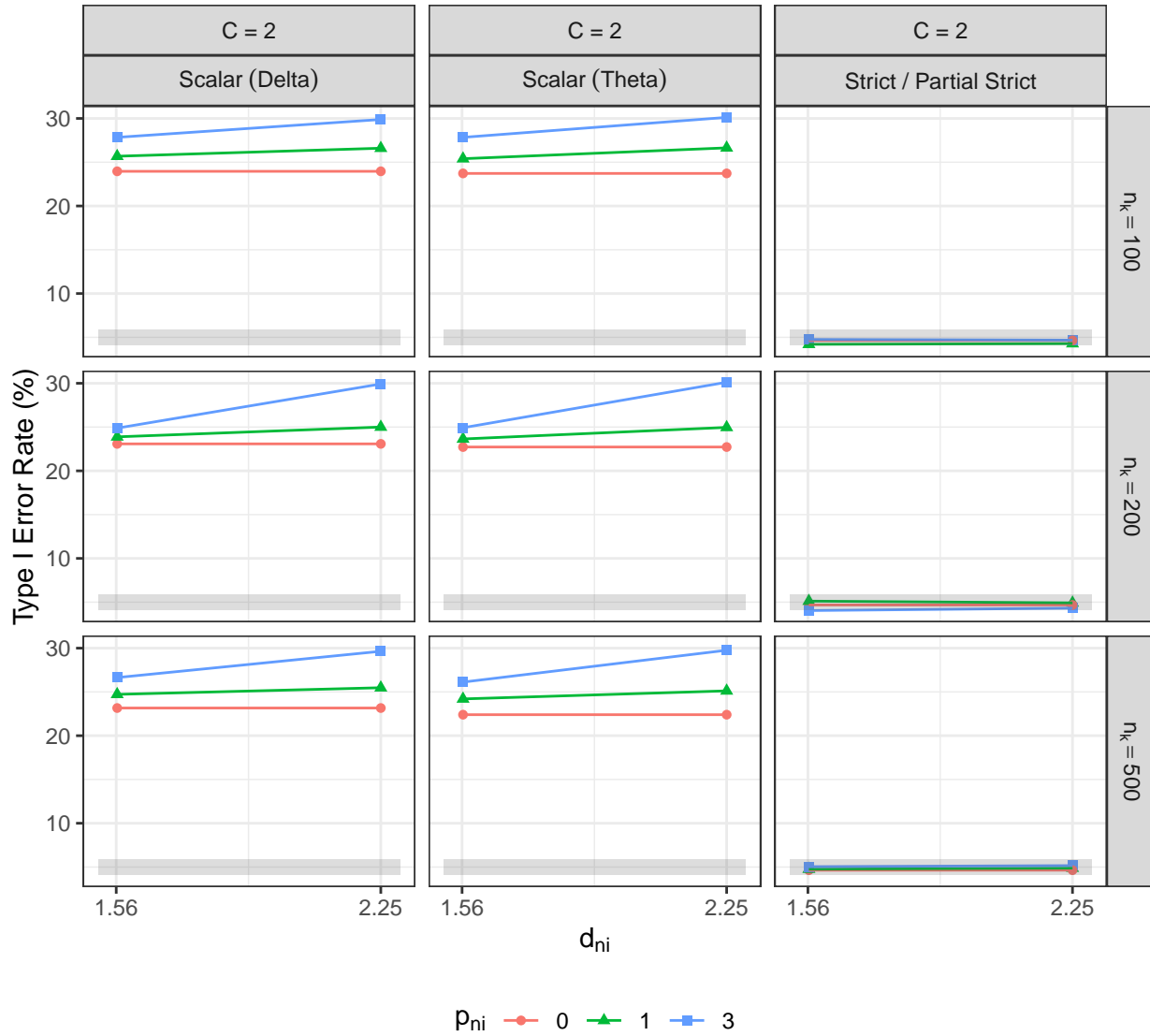
Table S22*Raw biases of the observed mean difference estimates (Cont.)*

C	n_k	p_{ni}	d_{ni}	$\alpha_f = 0$	$\alpha_f = 0.2$	$\alpha_f = 0.5$
7	2000	0		0.00	0.00	0.00
			Small	-0.01	-0.01	-0.02
		1	Large	-0.02	-0.03	-0.03
			Small	-0.04	-0.04	-0.05
		3	Large	-0.07	-0.08	-0.09

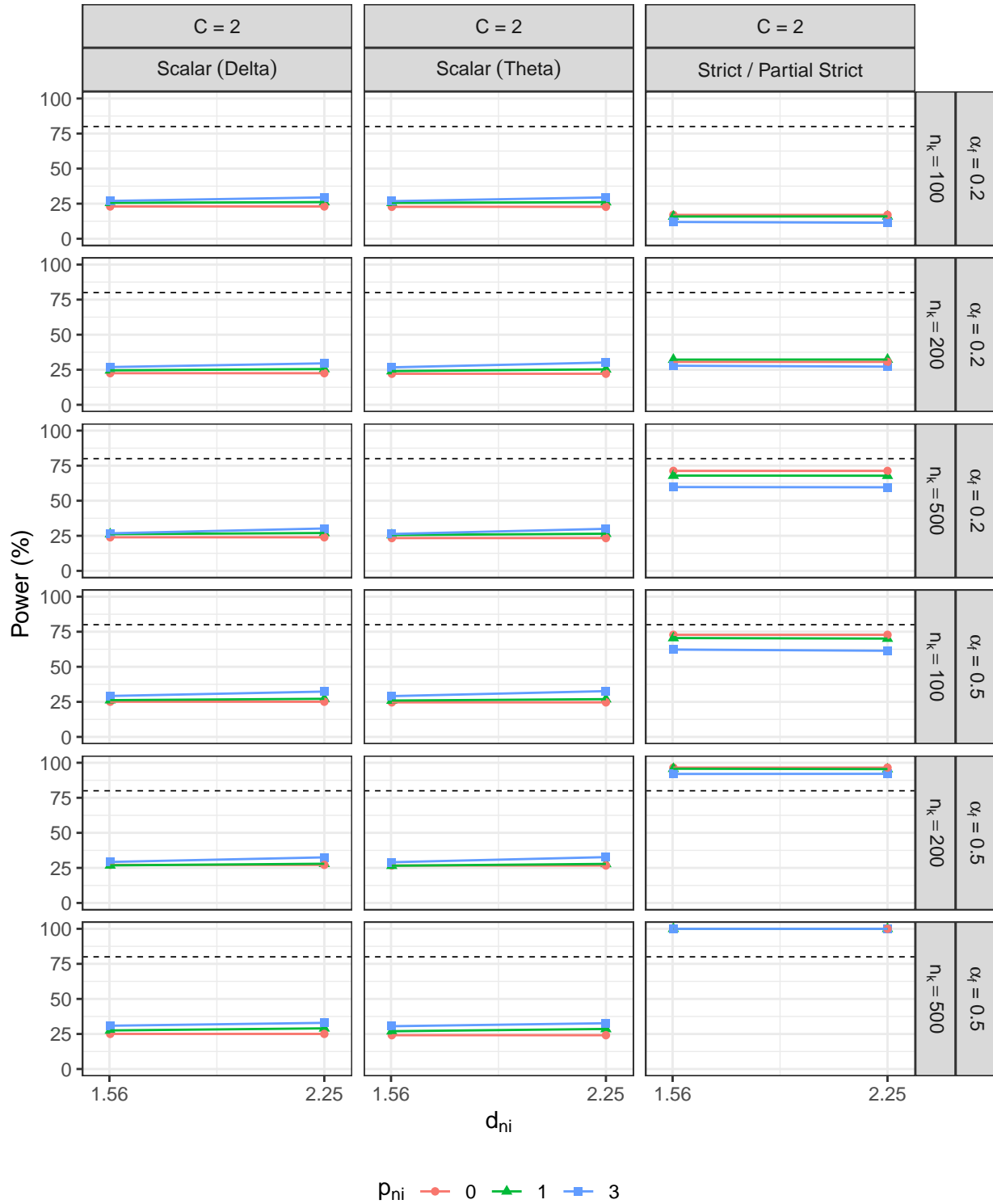
Note. C = number of response categories. n_k = group size. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean difference.

Figure S1

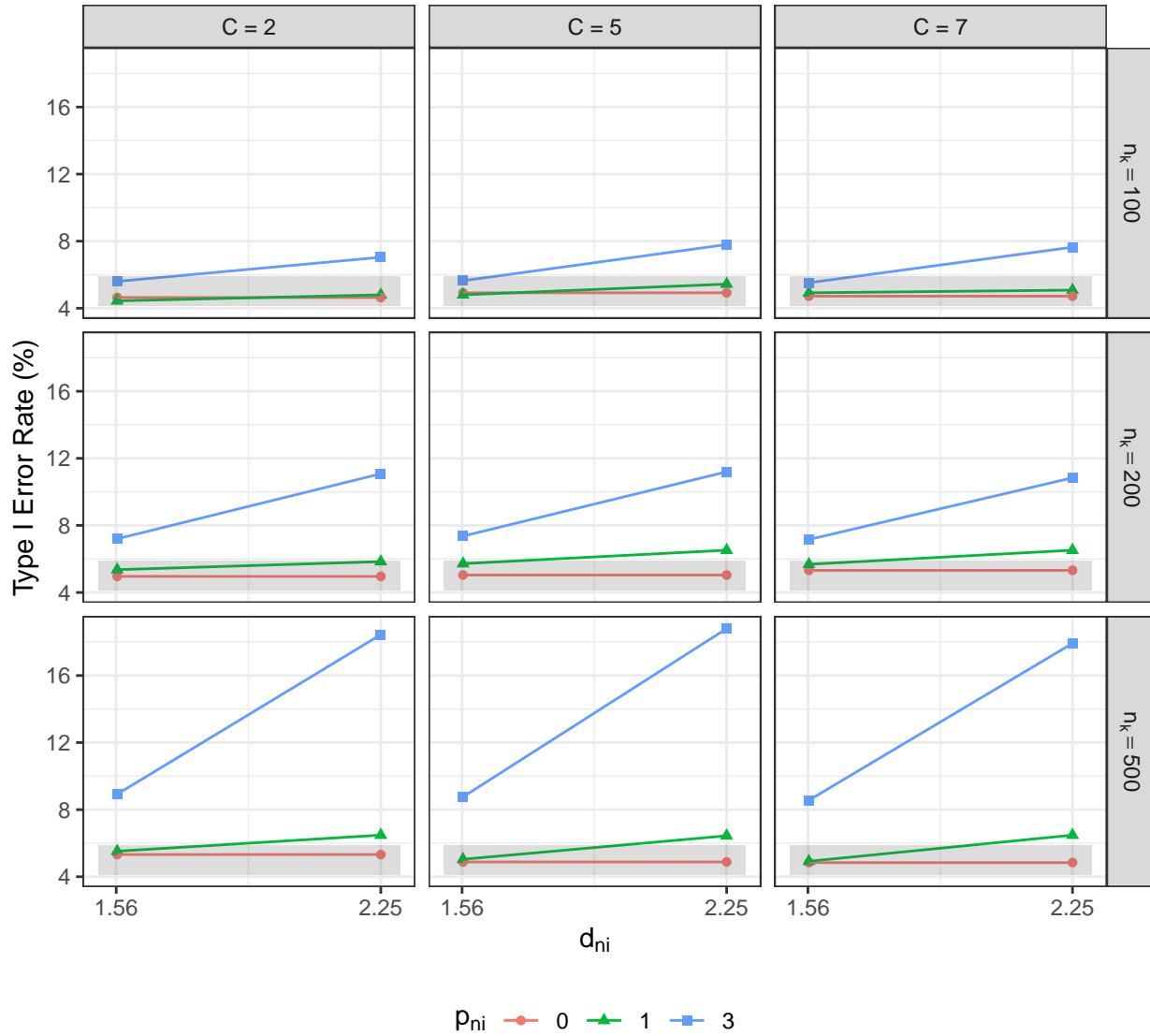
Type I error rate of the factor mean comparisons with dichotomous items.



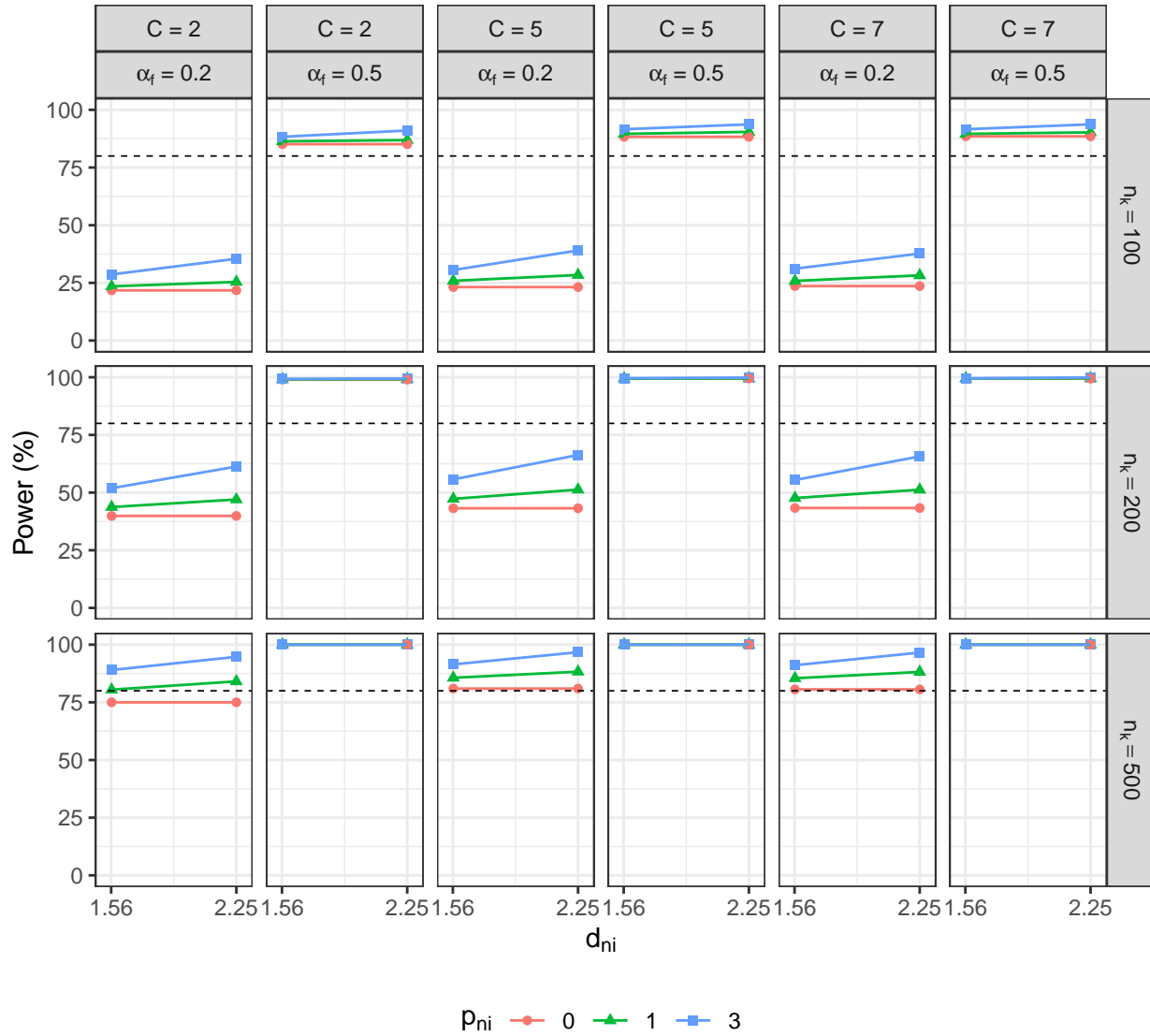
Note. n_k = group size. C = number of response categories. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean of the focal group. Scalar (Delta) = the scalar invariance model with delta parameterization. Scalar (Theta) = the scalar invariance model with theta parameterization. (Partial) Strict = the strict invariance model if all items are invariant or the partial strict invariance model if some items demonstrate unique factor noninvariance. The shaded area is the acceptable range of Type I error rates, 4.13%-5.87%, in this study.

Figure S2*Statistical power of the factor mean comparisons with dichotomous items.*

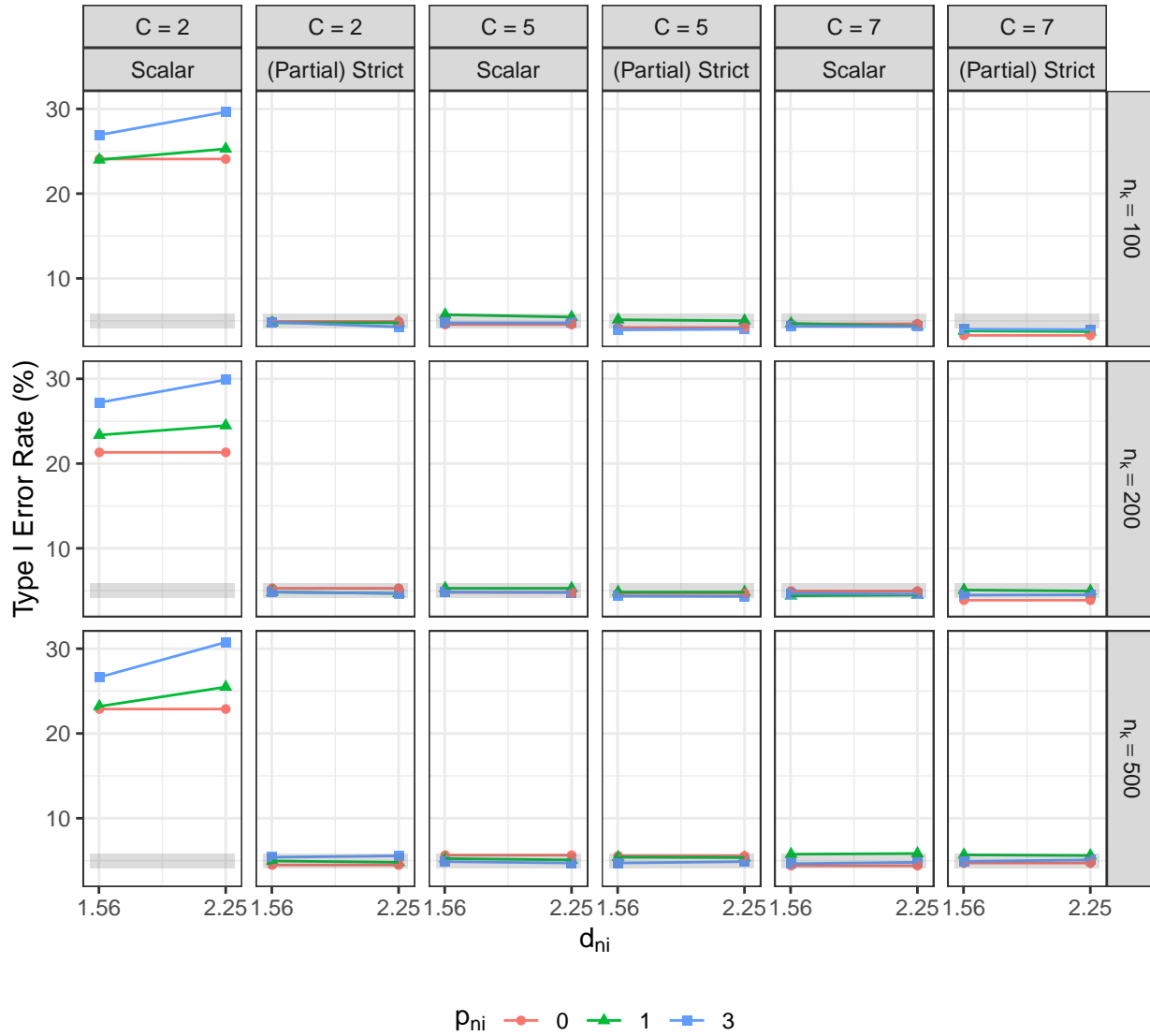
Note. n_k = group size. C = number of response categories. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean of the focal group. Scalar (Delta) = the scalar invariance model with delta parameterization. Scalar (Theta) = the scalar invariance model with theta parameterization. (Partial) Strict = the strict invariance model if all items are invariant or the partial strict invariance model if some items demonstrate unique factor noninvariance. The dashed line indicates 80% power.

Figure S3*Type I Error Rate of the Observed Mean Comparisons.*

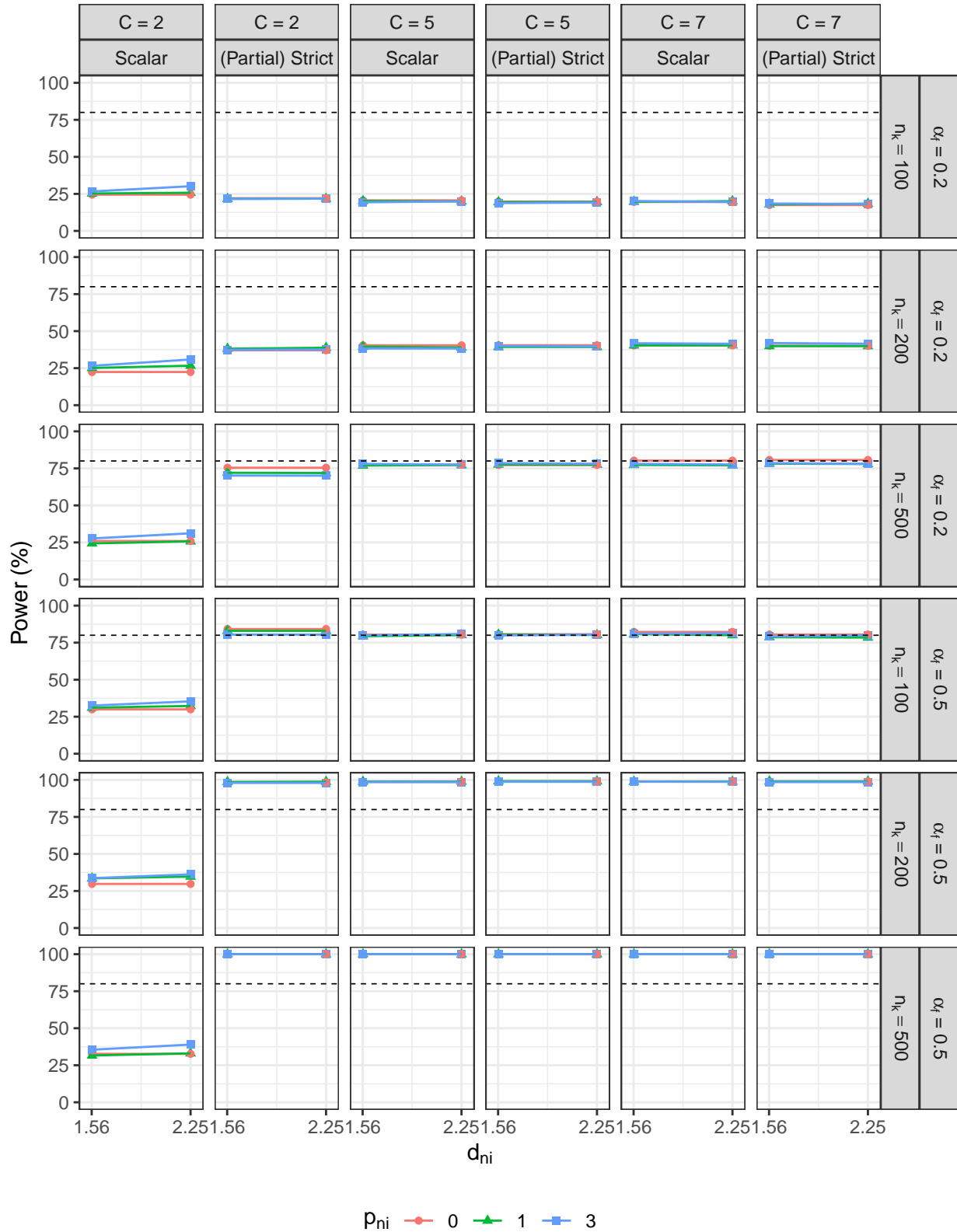
Note. n_k = group size. C = number of response categories. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean of the focal group. The shaded area is the acceptable range of Type I error rates, 4.13%-5.87%, in this study.

Figure S4*Statistical Power of the Observed Mean Comparisons.*

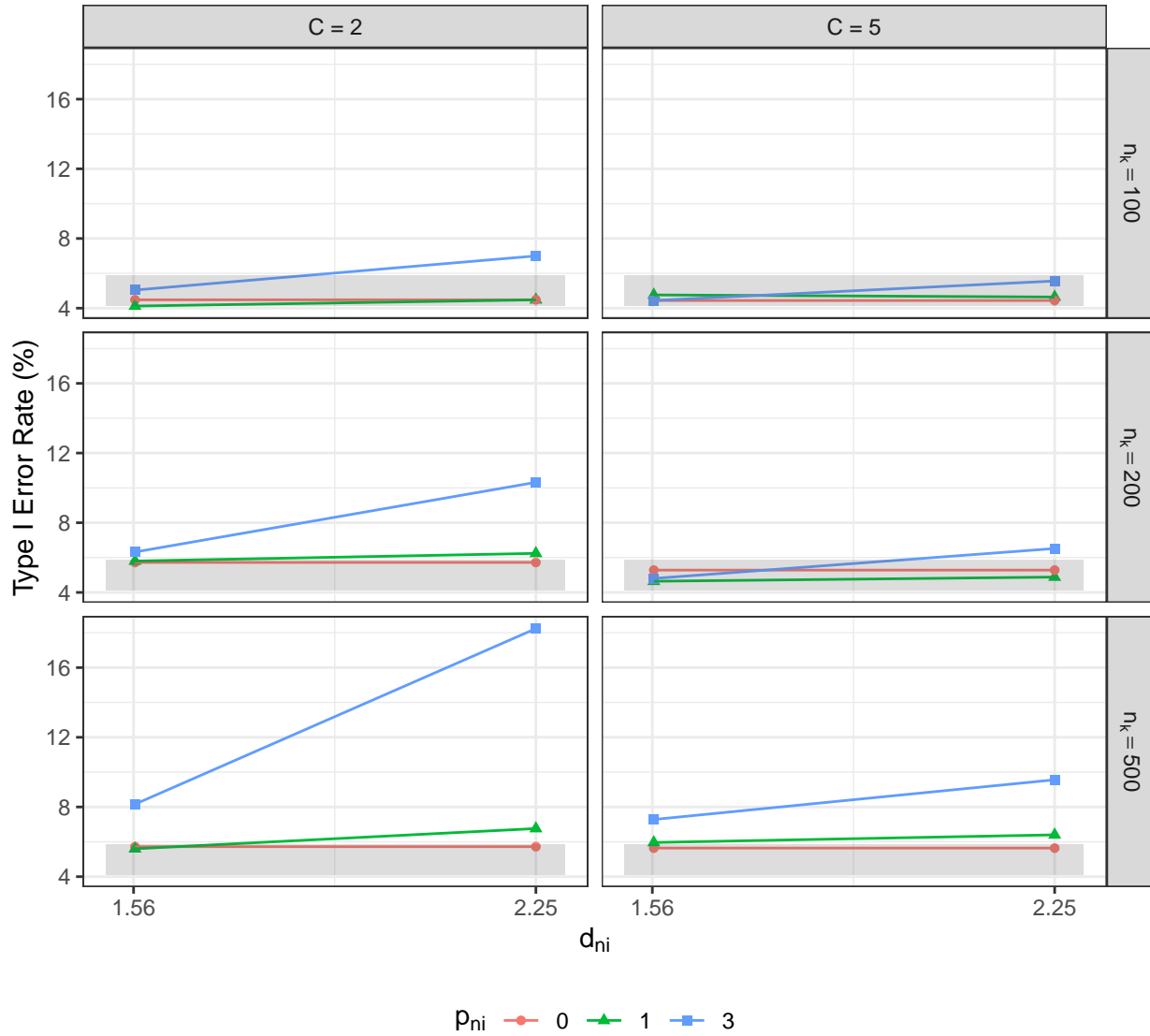
Note. n_k = group size. C = number of response categories. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean of the focal group. The dashed line indicates 80% power.

Figure S5*Type I Error Rate of the Factor Mean Comparisons.*

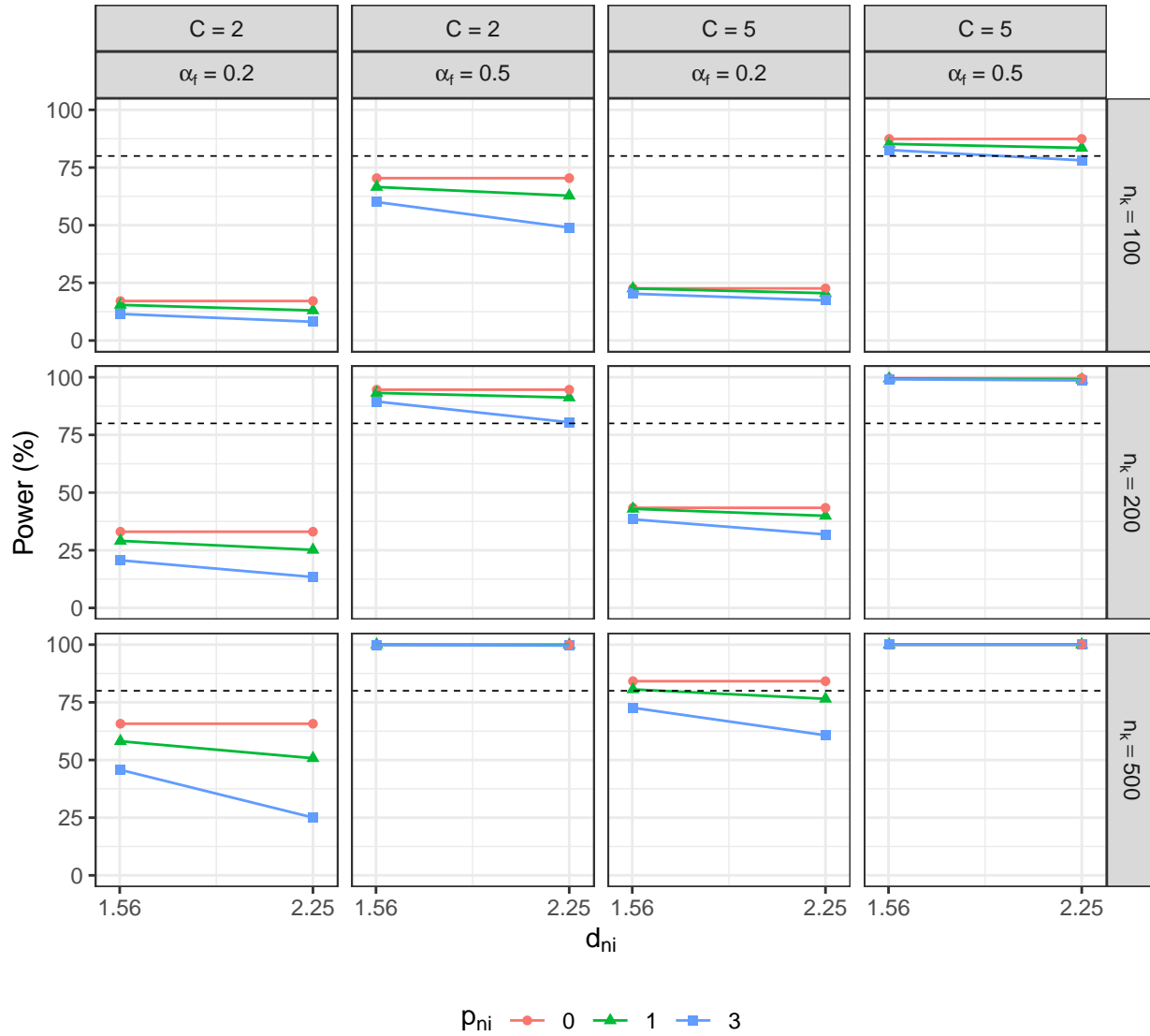
Note. n_k = group size. C = number of response categories. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean of the focal group. Scalar = the scalar invariance model. (Partial) Strict = the strict invariance model if all items are invariant or the partial strict invariance model if some items demonstrate unique factor noninvariance. The shaded area is the acceptable range of Type I error rates, 4.13%-5.87%, in this study.

Figure S6*Statistical Power of the Factor Mean Comparisons.*

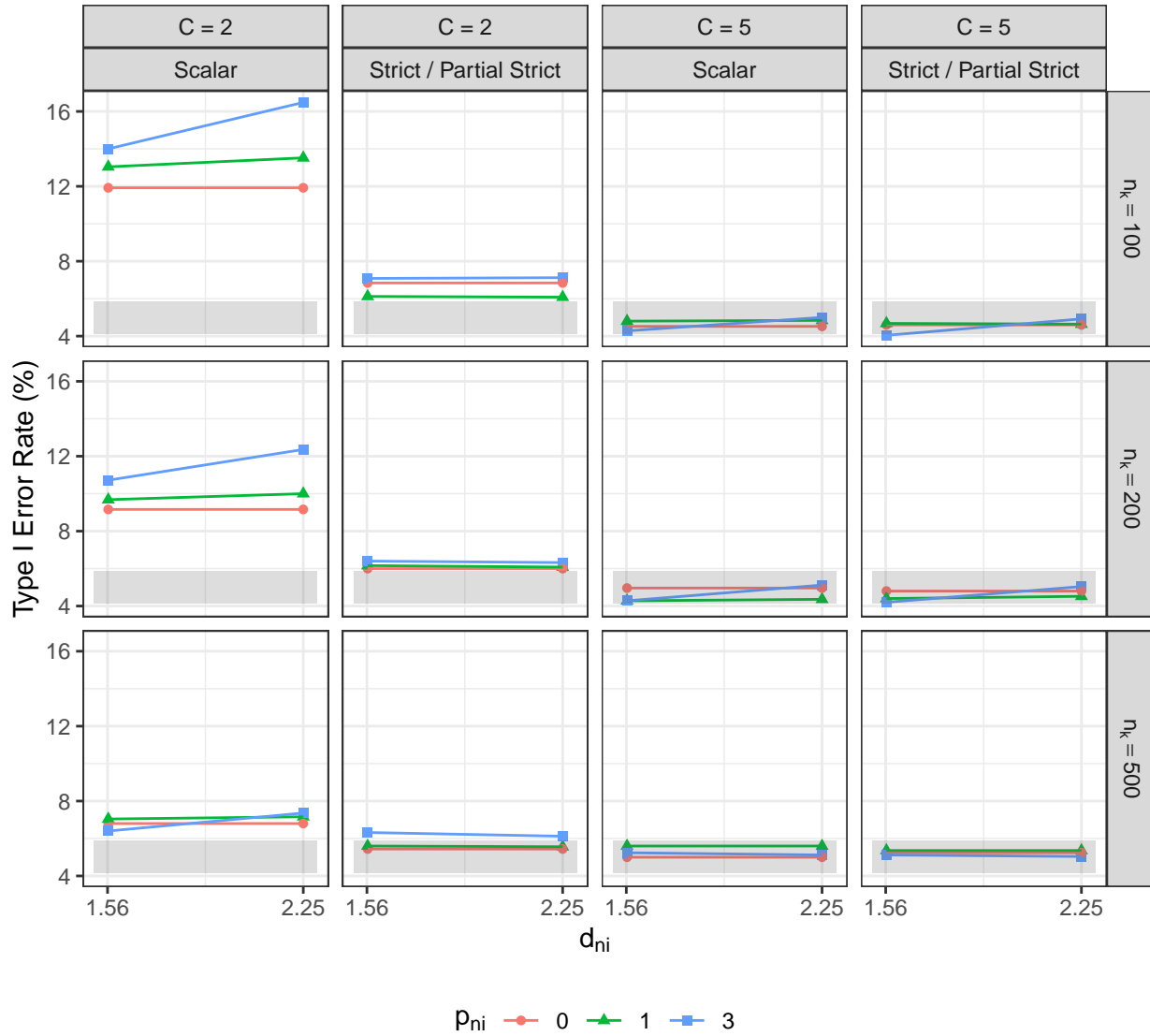
Note. n_k = group size. C = number of response categories. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean of the focal group. Scalar = the scalar invariance model. (Partial) Strict = the strict invariance model if all items are invariant or the partial strict invariance model if some items demonstrate unique factor noninvariance. The dashed line indicates 80% power.

Figure S7*Type I Error Rate of the Observed Mean Comparisons.*

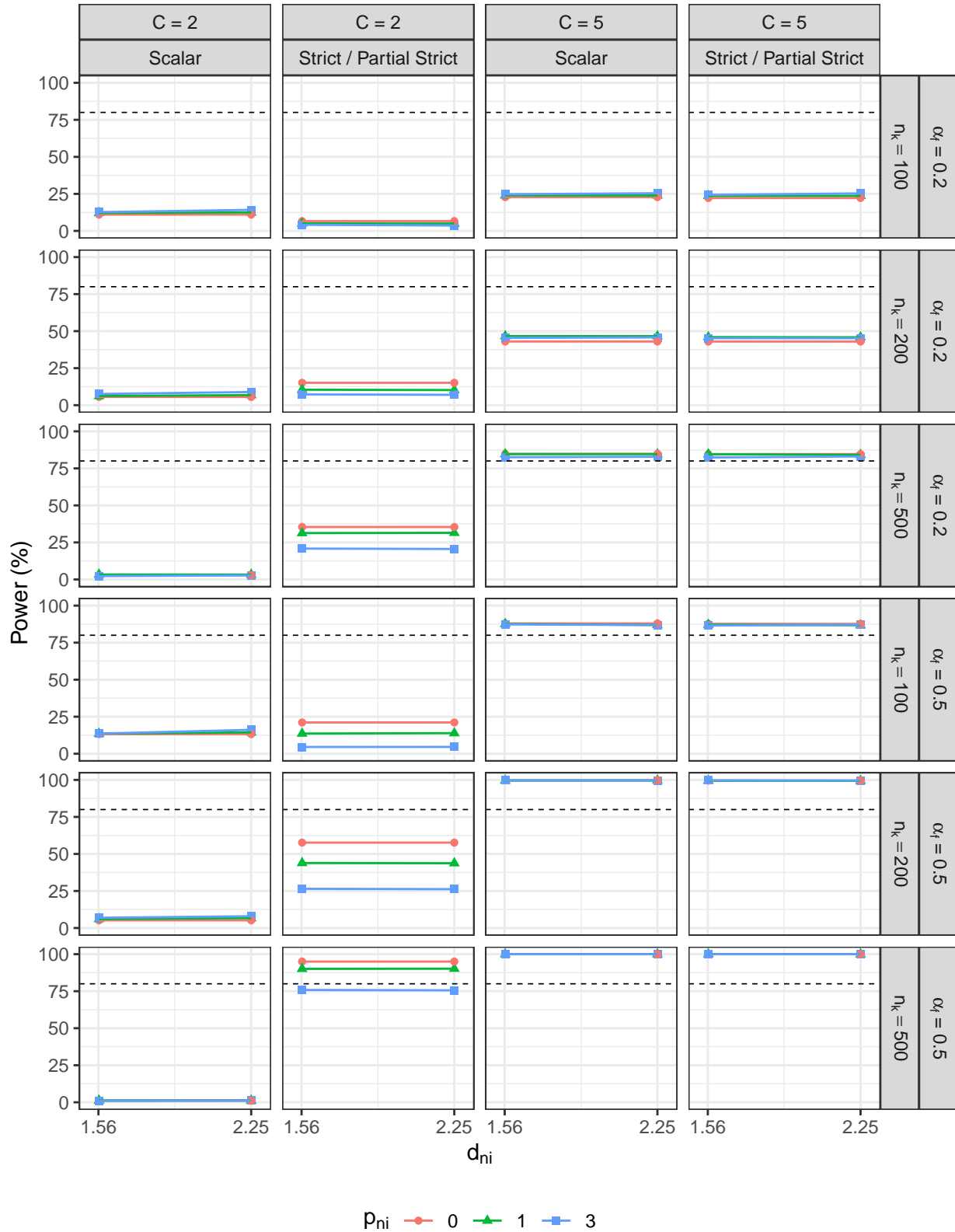
Note. n_k = group size. C = number of response categories. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean of the focal group. The shaded area is the acceptable range of Type I error rates, 4.13%-5.87%, in this study.

Figure S8*Statistical Power of the Observed Mean Comparisons.*

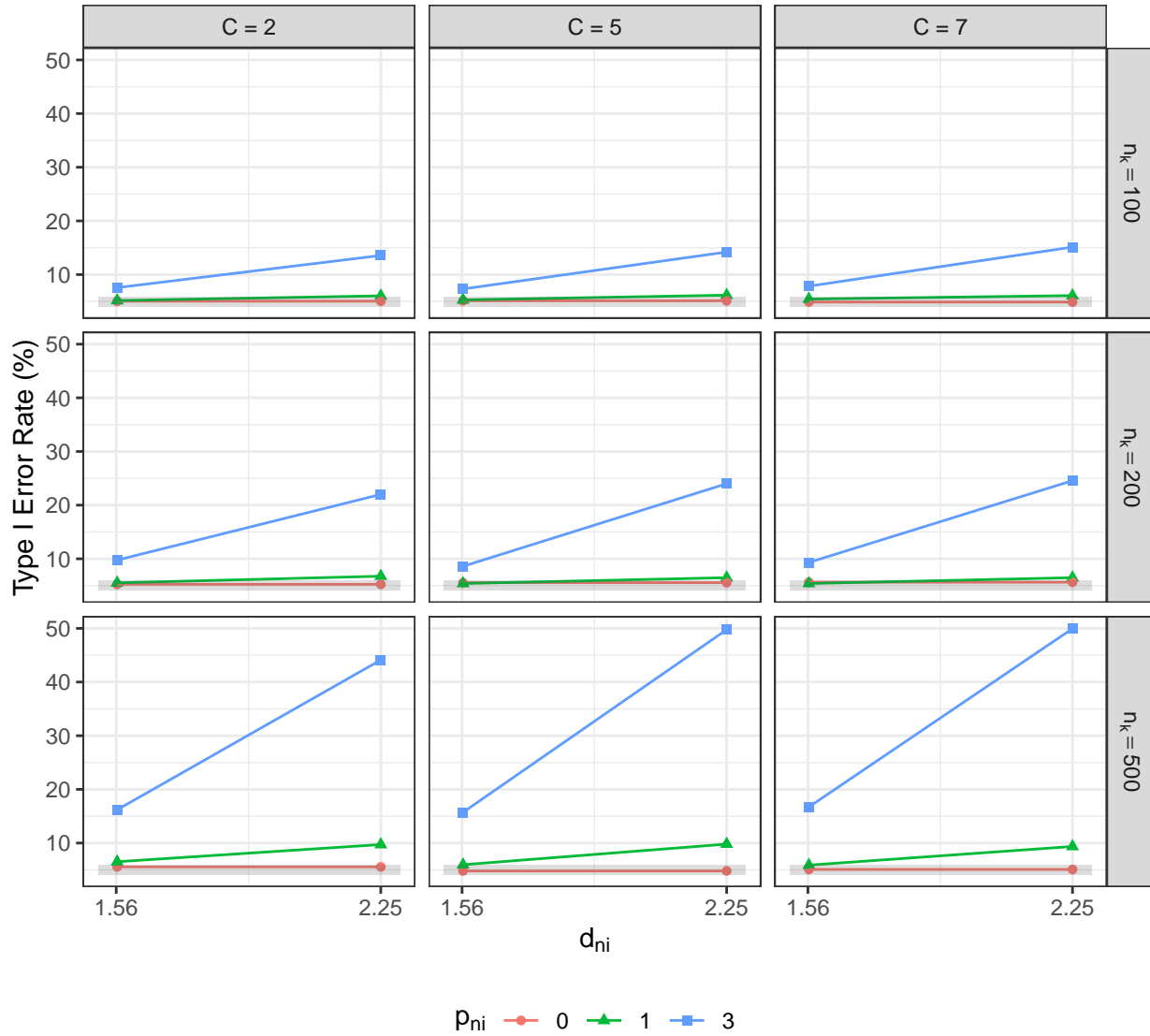
Note. n_k = group size. C = number of response categories. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean of the focal group. The dashed line indicates 80% power.

Figure S9*Type I Error Rate of the Factor Mean Comparisons.*

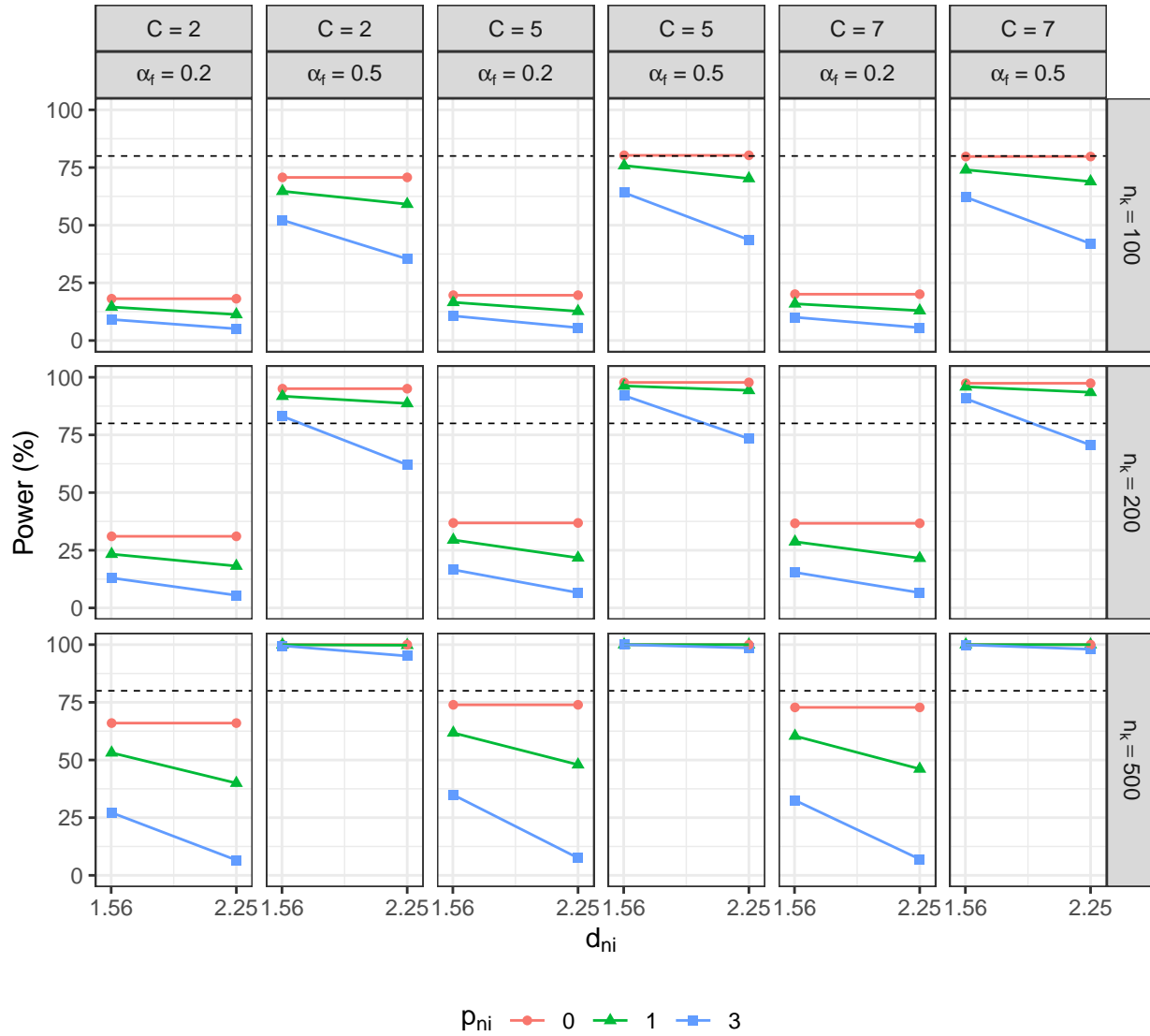
Note. n_k = group size. C = number of response categories. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean of the focal group. Scalar = the scalar invariance model. (Partial) Strict = the strict invariance model if all items are invariant or the partial strict invariance model if some items demonstrate unique factor noninvariance. The shaded area is the acceptable range of Type I error rates, 4.13%-5.87%, in this study.

Figure S10*Statistical Power of the Factor Mean Comparisons.*

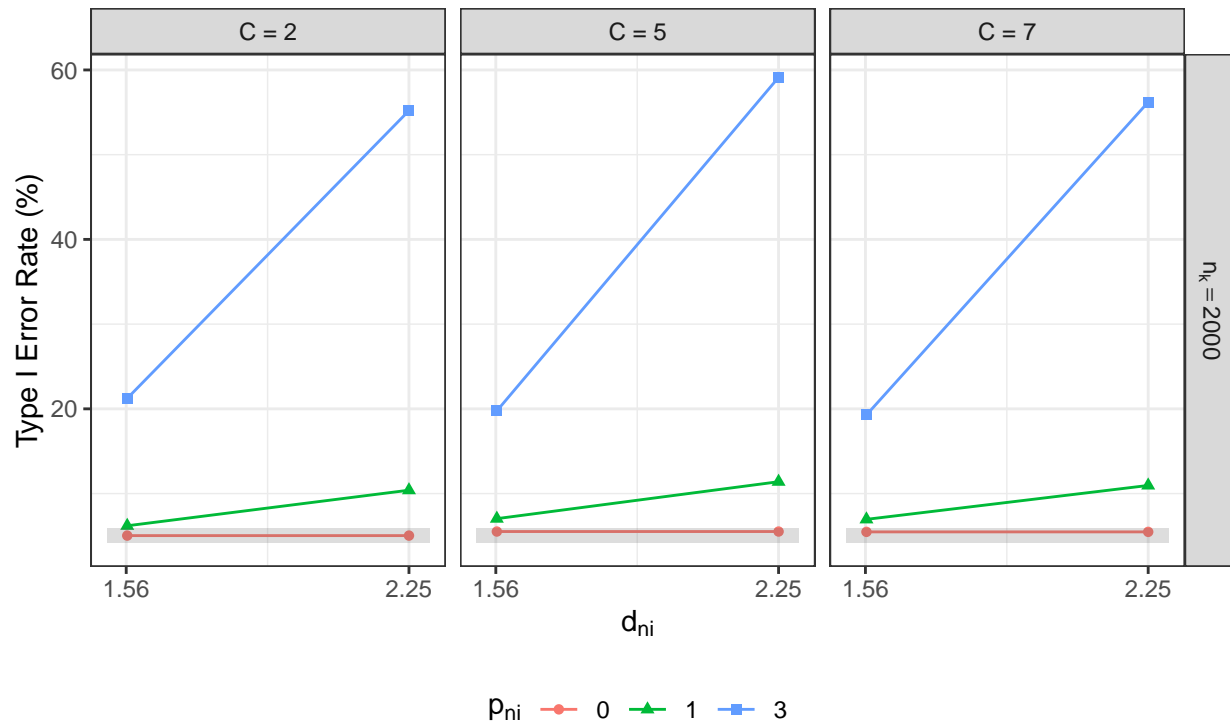
Note. n_k = group size. C = number of response categories. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean of the focal group. Scalar = the scalar invariance model. (Partial) Strict = the strict invariance model if all items are invariant or the partial strict invariance model if some items demonstrate unique factor noninvariance. The dashed line indicates 80% power.

Figure S11*Type I Error Rate of the Observed Mean Comparisons.*

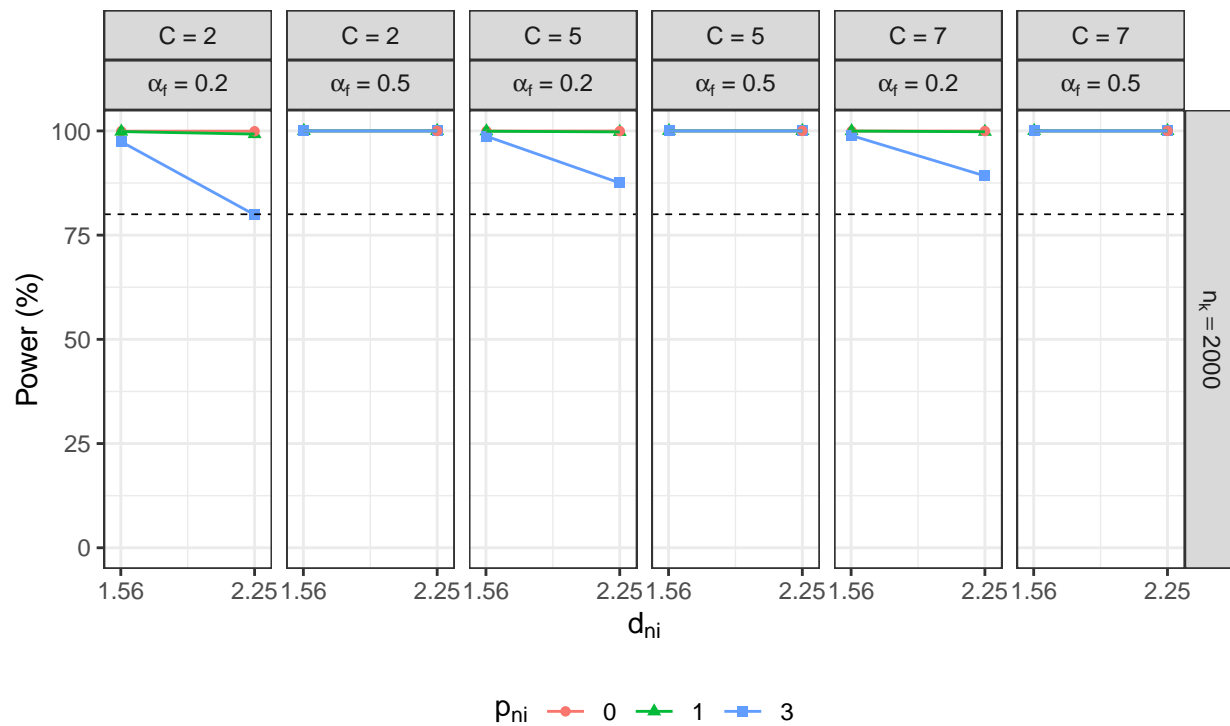
Note. n_k = group size. C = number of response categories. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean of the focal group. The shaded area is the acceptable range of Type I error rates, 4.13%-5.87%, in this study.

Figure S12*Statistical Power of the Observed Mean Comparisons.*

Note. n_k = group size. C = number of response categories. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean of the focal group. The dashed line indicates 80% power.

Figure S13*Type I Error Rate of the Observed Mean Comparisons.*

Note. n_k = group size. C = number of response categories. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean of the focal group. The shaded area is the acceptable range of Type I error rates, 4.13%-5.87%, in this study.

Figure S14*Statistical Power of the Observed Mean Comparisons.*

Note. n_k = group size. C = number of response categories. p_{ni} = number of unique factor noninvariant items. d_{ni} = degree of unique factor noninvariance. α_f = population factor mean of the focal group. The dashed line indicates 80% power.