

Prospective rotator cuff syndrome study

Supplemental Table 1. Hazard ratios and p-values for univariable survival analyses for demographic and psychosocial covariates with p-values $\geq .20$, in ascending order by p-value. None of these variables were considered potential confounders.

Characteristic	Hazard Ratio	95% CI	p-value
Resource control	0.68	0.36–1.31	0.25
Skill discretion	0.97	0.91–1.03	0.27
Decision latitude	0.98	0.95–1.02	0.32
Depression (POMS)	1.06	0.91–1.25	0.45
Current smoking	0.74	0.32–1.71	0.48
Thyroid disease	1.18	0.35–4.00	0.79
Decision authority	0.98	0.93–1.03	0.48
Task control	1.14	0.75–1.75	0.54
Ethnicity			0.54
Caucasian (referrent group)			
Asian	3.06	0.35–26.43	0.31
African American	1.66	0.82–3.35	0.16
Hispanic	0.75	0.10–5.74	0.78
Other	1.86	0.23–15.11	0.56
High vs. low decision latitude job strain category	0.83	0.42–1.66	0.60
Depression (CES-D scale score (sum))	1.02	0.96–1.08	0.55
Depression (CES-D scale mean)	1.29	0.56–2.95	0.55
Years worked in current occupation	1.01	0.97–1.06	0.55
Task control (expanded version)	1.10	0.71–1.72	0.67
Coworker support	1.12	0.67–1.86	0.67
Years worked at current job	1.01	0.96–1.05	0.74
Job strain categories			0.74
Low strain (Quartile 1, reference group)			
Passive job (Quartile 2)	1.46	0.57–3.73	0.44
Active job (Quartile 3)	1.74	0.59–5.10	0.32
Job strain (Quartile 4)	1.64	0.59–4.52	0.34
Workgroup pressure	1.05	0.53–2.10	0.88

CI=confidence interval; POMS= Profile of Mood States ; CES-D= Center for Epidemiologic Studies Depression Scale .

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Supplemental Table 2. Unadjusted and adjusted Hazard Ratios (HR) with 95% Confidence Intervals (CI) for linear (trend) associations between biomechanical exposures and incident rotator cuff syndrome (N=393). Footnotes in the last column describe how each model was adjusted for confounding by demographic, psychosocial, or biomechanical exposures from other domains.

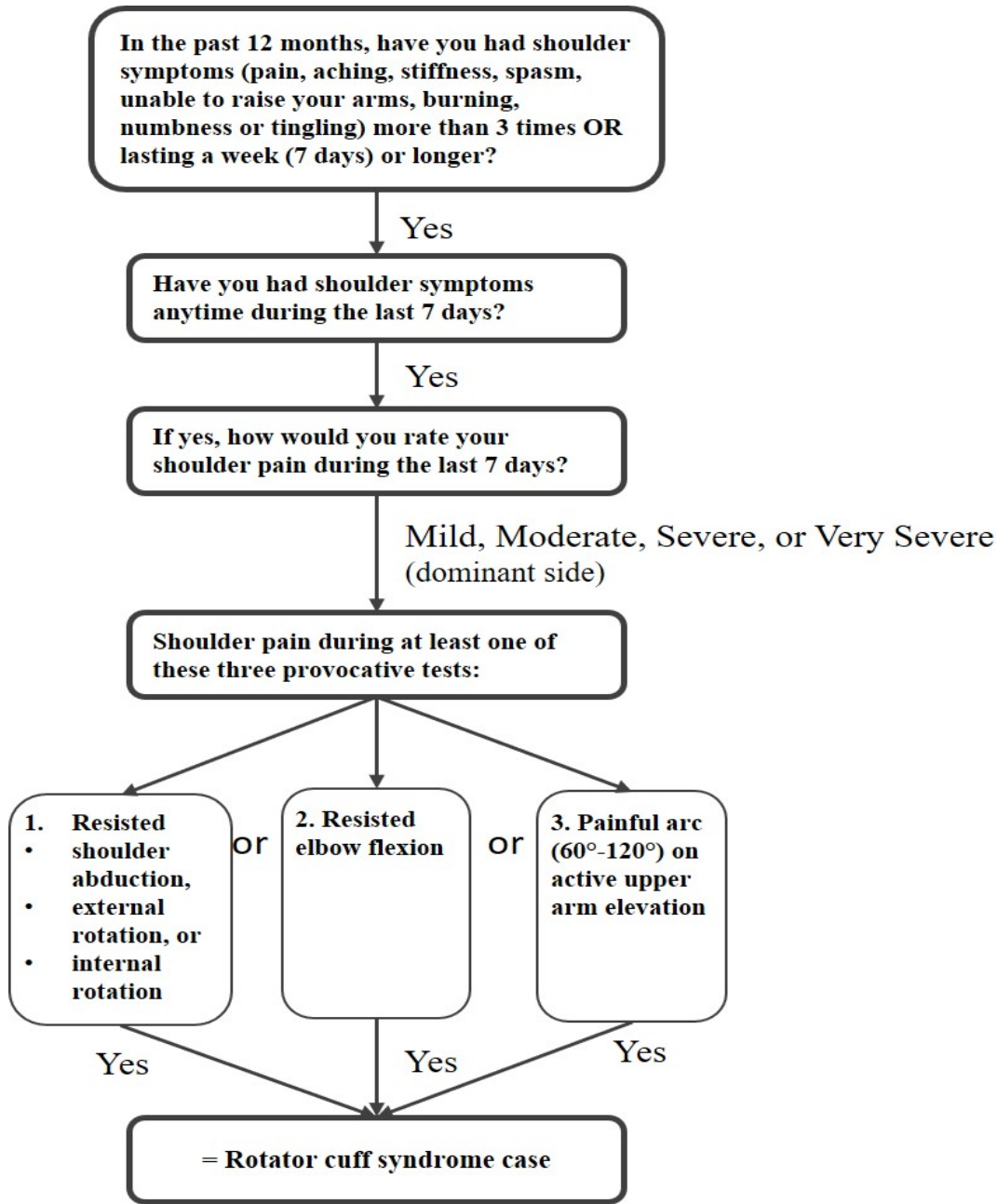
Exposure variables	Unadjusted linear effects			Adjusted linear effect			Confounder [†] (codes a-)
	HR	95% CI	p-value	HR	95% CI	p-value	
<u>Non-posture exposure domains</u>							
Forceful Exertion							
Peak forceful exertion - analyst rated	1.02	0.57–1.85	0.94	0.97	0.46–2.04	0.93	abcdefj
TWA forceful exertion - analyst rated	1.20	0.72–1.99	0.48	0.60	0.23–1.59	0.31	adej
Peak forceful exertion - worker rated	1.11	0.69–1.79	0.66	0.91	0.43–1.95	0.81	cdefghij
TWA forceful exertion - worker rated	1.12	0.74–1.71	0.58	0.79	0.42–1.48	0.46	abcdej
Repetition Rates (/min)							
TWA total repetition rate (/min)	1.02	0.99–1.05	0.22	1.00	0.97–1.04	0.81	abcefg hij
TWA forceful repetition rate (/min)*‡				1.06	0.98–1.14	0.14	cefh
Duty Cycle (% Time)							
Total duty cycle (%Time)	1.01	0.99–1.03	0.38	1.00	0.98–1.02	0.95	abcdefghijklmnop
Forceful duty cycle‡ (%Time)‡	1.01	0.99–1.02	0.55	1.00	0.97–1.03	0.78	adej
Vibration (yes/no)	1.10	0.52–2.30	0.81	0.76	0.26–2.22	0.61	acdefij
<u>Upper arm posture variables (% Time)</u>							
Abduction ≥ 30°	0.99	0.97–1.02	0.46	0.98	0.95–1.01	0.23	abcdfi
Flexion ≥ 45°	0.99	0.97–1.01	0.29	0.98	0.95–1.00	0.05	abdef
Abduction ≥ 60°	0.99	0.94–1.03	0.53	0.97	0.93–1.03	0.32	be
Flexion ≥ 90°	0.99	0.93–1.04	0.60	0.97	0.91–1.03	0.30	bcdeg

TWA = time weighted average

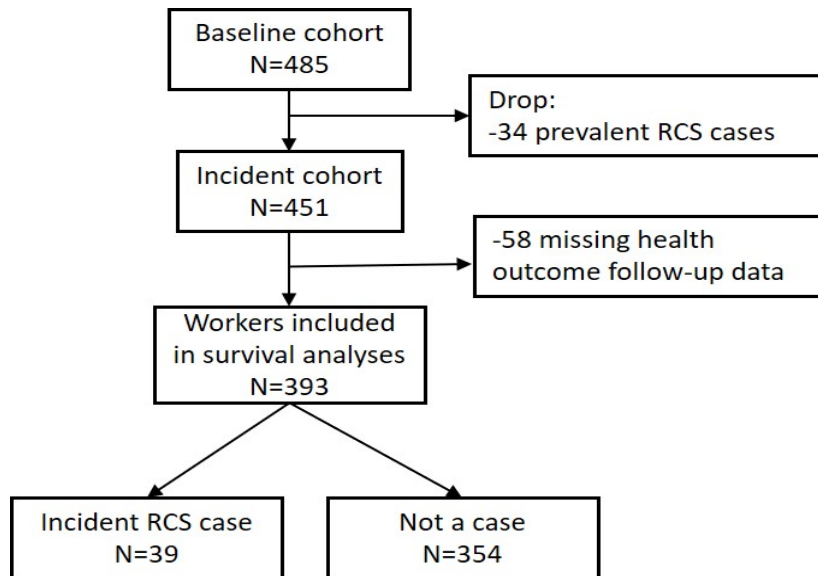
[†]a= Age (years); b= Education - at least a high school graduate; c= BMI (kg/m²); d= Forceful Element Repetition Rate (TWA) - median split; e= Site (N=3); f= Supervisor support; g= Years worked at employer; h= Job strain ratio; i= Mental demands.

*p-value < .05

‡Combination of multiple exposure domains



Supplemental Figure 3. Our case definition for dominant arm rotator cuff syndrome case included a combination of shoulder symptoms and shoulder pain in response to one of three provocative tests. Participants who did not meet all criteria were not considered a case.



Supplemental Figure 4. Study population

RCS=rotator cuff syndrome

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Supplemental Table 3. Biomechanical exposure and risk of rotator cuff tendinosis: interactions between TWA and peak measures of forceful exertion ratings by analysts or workers (Borg scale) and tertiles of all posture exposures (% time).

Non-posture variable	Posture variable	Tertile ranges			P*	HR across tertiles ^{6,5}	confounders [†]
		(% time)	HR	95% CI			
Analyst Rated Force (Peak)	≥ 30° upper arm abduction	< 11.9	0.92	0.38–2.24	0.86		abcdefj
		≥ 11.9–< 21.3	0.64	0.13–3.12	0.58		
		≥ 21.3	0.86	0.15–4.89	0.86		
		≥ 21.3	1.44	0.55–3.81	0.46		
Analyst Rated Force (TWA)	≥ 30° upper arm abduction	< 11.9	0.64	0.24–1.69	0.37		edef
		≥ 11.9–< 21.3	0.45	0.11–1.88	0.27		
		≥ 21.3	0.95	0.18–4.87	0.95		
		≥ 21.3	0.61	0.17–2.11	0.43		
Worker Rated Force (Peak)	≥ 30° upper arm abduction	< 11.9	0.93	0.33–2.57	0.88		cdefghij
		≥ 11.9–< 21.3	0.44	0.05–4.13	0.48		
		≥ 21.3	1.79	0.35–9.26	0.49		
		≥ 21.3	1.00	0.36–2.79	1.00		
Worker Rated Force (TWA)	≥ 30° upper arm abduction	< 11.9	0.73	0.38–1.41	0.35		abcdej
		≥ 11.9–< 21.3	0.57	0.16–1.96	0.37		
		≥ 21.3	1.00	0.44–2.27	0.99		
		≥ 21.3	0.69	0.26–1.87	0.47		
Analyst Rated Force (Peak)	≥ 45° upper arm flexion	< 16.7	1.02	0.46–2.24	0.96		abcdefj
		≥ 16.7–28.2	0.88	0.24–3.25	0.85		
		≥ 28.2	1.25	0.33–4.71	0.74		
		≥ 28.2	0.96	0.28–3.28	0.95		
Analyst Rated Force (TWA)	≥ 45° upper arm flexion	< 16.7	0.63	0.23–1.77	0.38		edef
		≥ 16.7–28.2	1.15	0.24–5.58	0.86		
		≥ 28.2	0.38	0.07–1.98	0.25		
		≥ 28.2	0.58	0.16–2.04	0.39		
Worker Rated Force (Peak)	≥ 45° upper arm flexion	< 16.7	0.85	0.36–1.99	0.71		cdefghij
		≥ 16.7–28.2	0.71	0.15–3.41	0.66		
		≥ 28.2	1.03	0.31–3.46	0.96		
		≥ 28.2	0.85	0.22–3.19	0.80		
Worker Rated Force (TWA)	≥ 45° upper arm flexion	< 16.7	0.73	0.36–1.47	0.38		abcdej
		≥ 16.7–28.2	0.74	0.23–2.37	0.62		
		≥ 28.2	0.55	0.15–1.96	0.35		
		≥ 28.2	0.96	0.43–2.18	0.93		
Analyst Rated Force (Peak)	≥ 60° upper arm abduction ⁵	< 4.8	0.98	0.46–2.12	0.97		abcdefj
		≥ 4.8	0.66	0.20–2.16	0.50		
		≥ 4.8	1.00	0.96–1.04	0.91		
Analyst Rated Force (TWA)	≥ 60° upper arm abduction ⁵	< 4.8	0.67	0.26–1.74	0.41		edef
		≥ 4.8	0.61	0.19–1.94	0.40		
		≥ 4.8	1.46	0.58–3.64	0.42		
Worker Rated Force (Peak)	≥ 60° upper arm abduction ⁵	< 4.8	0.95	0.43–2.11	0.91		cdefghij
		≥ 4.8	0.83	0.30–2.28	0.72		
		≥ 4.8	0.72	0.20–2.65	0.63		
Worker Rated Force (TWA)	≥ 60° upper arm abduction ⁵	< 4.8	0.80	0.43–1.50	0.48		abcdej
		≥ 4.8	0.90	0.42–1.89	0.77		
		≥ 4.8	1.09	0.36–3.34	0.88		

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Non-posture variable	Posture variable	Tertile ranges			95% CI	P*	HR across tertiles ^{€,§}	confounders [†]
		(% time)	HR					
Analyst Rated Force (Peak)	≥ 90° upper arm flexion [§]		1.02	0.48–2.13	0.97		abcdefj	
		< 3.5	1.03	0.40–2.66	0.95			
		≥ 3.5	1.00	0.34–2.92	1.00			
Analyst Rated Force (TWA)	≥ 90° upper arm flexion [§]		0.60	0.22–1.58	0.30		adej	
		< 3.5	0.69	0.22–2.17	0.53			
		≥ 3.5	0.51	0.14–1.93	0.32			
Worker Rated Force (Peak)	≥ 90° upper arm flexion [§]		0.76	0.29–2.03	0.59		cdefghij	
		< 3.5	1.03	0.46–2.32	0.94			
		≥ 3.5	0.57	0.11–2.98	0.50			
Worker Rated Force (TWA)	≥ 90° upper arm flexion [§]		0.76	0.40–1.44	0.40		abcdej	
		< 3.5	0.87	0.42–1.83	0.72			
		≥ 3.5	0.66	0.26–1.68	0.38			

*Large black dots indicate statistical significance in the P-value column; €Vertical axis varies by sparkline; †a= Age (years); b= Educ - at least a high school graduate; c= BMI (kg/m²); d= Forceful Element Repetition Rate (TWA) - median split; e= Site (N=3); f= Supervisor support; g= Years worked at employer; h= Job strain ratio (pd/dl); i= Mental demands.

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Supplemental Table 4. Biomechanical exposure and risk of rotator cuff tendinosis: interactions between total and forceful repetition rates (/minute) and tertiles of all posture exposures (% time).

Non-posture variable	Posture variable	Tertile ranges (% time)	HR	95% CI	P*	HR across tertiles ^{€,§}	confounders [†]
Total Repetition Rate	≥ 30° upper arm abduction	< 11.9	1.01	0.96–1.06	0.65		abcefghij
		≥ 11.9–< 21.3	0.94	0.84–1.04	0.23		
		≥ 21.3	1.11	1.01–1.21	0.02		
Forceful Repetition Rate‡	≥ 30° upper arm abduction	< 11.9	1.00	0.95–1.05	0.96		cefh
		≥ 11.9–< 21.3	0.96	0.82–1.12	0.61		
		≥ 21.3	1.18	1.04–1.34	0.01		
Total Repetition Rate	≥ 45° upper arm flexion	< 16.7	1.00	0.96–1.05	0.93		abcefghij
		≥ 16.7–28.2	0.97	0.87–1.08	0.55		
		≥ 28.2	1.01	0.94–1.08	0.79		
Forceful Repetition Rate‡	≥ 45° upper arm flexion	< 16.7	1.00	0.97–1.09	0.29		cefh
		≥ 16.7–28.2	1.00	0.89–1.13	0.99		
		≥ 28.2	1.05	0.92–1.20	0.50		
Total Repetition Rate	≥ 60° upper arm abduction [§]	< 4.8	1.01	0.97–1.05	0.53		abcefghij
		≥ 4.8	0.98	0.92–1.04	0.56		
		≥ 4.8	1.04	0.99–1.10	0.10		
Forceful Repetition Rate‡	≥ 60° upper arm abduction [§]	< 4.8	1.08	0.99–1.17	0.08		cefh
		≥ 4.8	1.00	0.89–1.12	0.98		
		≥ 4.8	1.16	1.04–1.29	0.01		
Total Repetition Rate	≥ 90° upper arm flexion [§]	< 3.5	1.02	0.98–1.06	0.36		abcefghij
		≥ 3.5	0.98	0.94–1.03	0.50		
		≥ 3.5	1.06	0.99–1.13	0.10		
Forceful Repetition Rate‡	≥ 90° upper arm flexion [§]	< 3.5	1.06	0.99–1.15	0.11		cefh
		≥ 3.5	1.05	0.96–1.15	0.29		
		≥ 3.5	1.07	0.96–1.20	0.22		

*Large black dots indicate statistical significance in the P-value column; €Vertical axis varies by sparkline; †a= Age (years); b= Educ - at least a high school graduate; c= BMI (kg/m²); d= Forceful Element Repetition Rate (TWA) - median split; e= Site (N=3); f= Supervisor support; g= Years worked at employer; h= Job strain ratio (pd/dl); i= Mental demands; j= Low ROM upper arm flexion or abduction; §Percent of the total range of motion [ROM] for neutral (0–20% ROM), non-neutral (21–40% ROM), and extreme non-neutral (>40% ROM). Total ROM was 60° extension or 180° for upper arm flexion or abduction.

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Supplemental Table 5. Biomechanical exposure and risk of rotator cuff tendinosis: interactions between total duty cycle or forceful duty cycle and tertiles of all posture exposures (% time).

Non-posture variable	Posture variable	Tertile ranges (% time)	HR	95% CI	P*	HR across tertiles ^{e,5}	confounders [†]
Total Duty Cycle	≥ 30° upper arm abduction		1.00	0.98–1.03	0.80		abcdefghijk
		< 11.9	1.00	0.97–1.04	0.91		
		≥ 11.9–< 21.3	0.98	0.94–1.02	0.39		
		≥ 21.3	1.03	0.98–1.08	0.28		
Forceful Duty Cycle‡	≥ 30° upper arm abduction		1.00	0.96–1.03	0.83		adef
		< 11.9	0.98	0.93–1.04	0.58		
		≥ 11.9–< 21.3	1.02	0.98–1.06	0.35		
		≥ 21.3	0.99	0.95–1.03	0.48		
Total Duty Cycle	≥ 45° upper arm flexion		1.00	0.98–1.03	0.83		abcdefghijk
		< 16.7	1.02	0.98–1.05	0.41		
		≥ 16.7–28.2	1.00	0.96–1.05	0.91		
		≥ 28.2	0.99	0.94–1.04	0.71		
Forceful Duty Cycle‡	≥ 45° upper arm flexion		0.99	0.96–1.03	0.73		adef
		< 16.7	1.01	0.97–1.05	0.67		
		≥ 16.7–28.2	0.97	0.92–1.02	0.22		
		≥ 28.2	1.01	0.97–1.05	0.71		
Total Duty Cycle	≥ 60° upper arm abduction [§]		1.00	0.97–1.03	0.97		abcdefghijk
		< 4.8	1.00	0.98–1.03	0.85		
		≥ 4.8	1.00	0.95–1.05	0.95		
			1.00	0.97–1.03	1.00		
Forceful Duty Cycle‡	≥ 60° upper arm abduction [§]		1.00	0.97–1.03	1.00		adef
		< 4.8	1.00	0.96–1.04	0.90		
		≥ 4.8	1.00	0.96–1.04	0.91		
			1.00	0.98–1.03	0.84		
Total Duty Cycle	≥ 90° upper arm flexion [§]		1.00	0.98–1.03	0.84		abcdefghijk
		< 3.5	1.00	0.97–1.03	0.93		
		≥ 3.5	1.00	0.96–1.05	0.85		
			1.00	0.97–1.03	0.85		
Forceful Duty Cycle‡	≥ 90° upper arm flexion [§]		1.00	0.97–1.03	0.85		adef
		< 3.5	1.00	0.96–1.03	0.91		
		≥ 3.5	1.00	0.96–1.04	0.86		
			1.00	0.96–1.04	0.86		

*Large black dots indicate statistical significance in the P-value column; †Vertical axis varies by sparkline; †a= Age (years); b= Educ - at least a high school graduate; c= BMI (kg/m²); d= Forceful Element Repetition Rate (TWA) - median split; e= Site (N=3); f= Supervisor support; g= Years worked at employer; h= Job strain ratio (pd/dl); i= Mental demands.

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Supplemental Table 6. Biomechanical exposure and risk of rotator cuff tendinosis: interactions between exposure to vibration and tertiles of all posture exposures (% time).

Non-posture variable	Posture variable	Tertile ranges (% time)	HR	95% CI	P*	HR across tertiles ^{€,\$}	confounders [†]
Vibration (yes/no)	≥ 30° upper arm abduction		0.55	0.16–1.92	0.35		acdefij
		< 11.9	0.37	0.03–4.18	0.42		
		≥ 11.9–< 21.3	0.36	0.04–3.08	0.35		
		≥ 21.3	1.24	0.32–4.82	0.76		
Vibration (yes/no)	≥ 45° upper arm flexion		NC	NC	0.99		acdefij
		< 16.7	NC	NC	0.99		
		≥ 16.7–28.2	0.27	0.03–2.05	0.20		
		≥ 28.2	2.06	0.50–8.55	0.32		
Vibration (yes/no)	≥ 60° upper arm abduction [§]		0.67	0.21–2.10	0.49		acdefij
		< 4.8	0.27	0.05–1.43	0.12		
		≥ 4.8	1.67	0.40–7.08	0.48		
Vibration (yes/no)	≥ 90° upper arm flexion [§]		0.30	0.04–2.51	0.27		acdefij
		< 3.5	0.04	0.00–2.39	0.13		
		≥ 3.5	1.99	0.50–7.97	0.33		

*Large black dots indicate statistical significance in the P-value column; €Vertical axis varies by sparkline; †a= Age (years); b= Educ - at least a high school graduate; c= BMI (kg/m²); d= Forceful Element Repetition Rate (TWA) - median split; e= Site (N=3); f= Supervisor support; g= Years worked at employer; h= Job strain ratio (pd/dl); i= Mental demands.