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Playing-related musculoskeletal problems in child instrumentalists: The influence of gender, age and instrument exposure

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Abstract

Playing-related musculoskeletal problems (PRMP) are common in adult musicians. The limited available evidence suggests PRMP are common in children and adolescents and that risk factors may be similar. The aim of this study was to determine the prevalence of PRMP in children and adolescents and their associations with female gender, age and instrument exposure. The study surveyed 731 children learning musical instruments (460 females) ranging in age from 7–17 years. Lifetime symptoms, monthly symptoms and monthly disorders (the inability to play an instrument as usual) were examined. Logistic regression evaluated the independent association of these potential risk factors with PRMP prevalences. A total of 67% students reported PRM symptoms at some point, 56% reported PRM symptoms within the last month and 30% reported an inability to play as usual within the last month. Female gender was significantly associated with PRMP (OR 1.38–1.56, $p = 0.004$–0.046), as was age (OR 1.19–0.23, $p < 0.001$). After adjustment for gender and age, type of instrument (upper and lower strings, woodwind and brass) were significantly associated with all PRMP ($p < 0.005$) and playing three instruments was protective against monthly symptoms (OR 0.43, $p = 0.05$).

The study concludes that the high prevalence and disabling impact of playing-related musculoskeletal problems is clearly an important issue for child and adolescent health with gender, age and instrument exposure important factors for risk management.

Keywords

age, child/adolescent instrumentalists, gender, instrument exposure, playing-related musculoskeletal problems, risk factors

Introduction

Playing-related musculoskeletal problems (PRMP) include muscle, nerve, bone and joint problems such as tendonitis, tenosynovitis, peripheral neuropathy and focal dystonia. These problems are not new, with ‘musician’s cramp’ and ‘pianist’s cramp’ recognized in the 1800s (Albert, 1895; Poore,

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1887) and noted to be similar to those seen in other occupations such as 'writer's cramp' and 'milking cramp' (Solly, 1867). PRMP are common in adults, with high prevalence rates in professional musicians (40–60%) and tertiary music students (9–90%), and may be severe enough to force career changes. Although PRMP are also known to exist in childhood there is limited evidence with respect to prevalence and risk factors. As musicians typically commence their careers at an early age, it is important to understand PRMP in childhood to help prevent problems in later years.

Twenty per cent (520,500) of Australian children play a musical instrument outside of school hours and 75% of these children receive instrumental tuition (ABS, 2006). Only five studies have examined the prevalence of PRMP specifically in children (Brown, 1997; Fry, Ross, & Rutherford, 1988; Fry & Rowley, 1989; Lockwood, 1988; Shoup, 1995) with a further four reporting some child prevalence data (Betuel & Clairet, 1999; Dawson, 1988; Fry, 1986b; Roset-Llobet, Rosines-Cubells, & Salo-Orfila, 2000). Whilst PRMP prevalence rates of 20%–60% have been reported, most of the studies had significant limitations including small sample sizes, recruitment biases and lack of clarity with case definitions.

PRMP in adult musicians have been classified into (1) mild aches and pains, experienced during and following playing, that may or may not affect performance (playing-related musculoskeletal symptoms – PRMS); and (2) pain, weakness, lack of control, numbness, tingling or other symptoms that interfered with the ability to play the instrument as usual (playing-related musculoskeletal disorders – PRMD) (Zaza, 1995). Examining symptoms in children may enable earlier detection and prevent the increase in symptoms, deterioration of function and subsequent development of more disabling disorders.

PRMP pathologies are similar to work-related musculoskeletal disorders (WRMSD). Risk factors are therefore thought to be similar and include intrinsic individual factors (e.g., age, gender), extrinsic playing-related factors (e.g., music exposure) and factors relating to the interaction of the individual and extrinsic factors (e.g., playing posture influenced by physical attributes of instrument). Whilst these factors have been investigated in adult instrumentalists, and subsequent management strategies recommended (Ackerman, 2003), it is not clear whether these risk factors are relevant for child instrumentalists.

Risk factors

The majority of existing studies of children have reported higher prevalences of PRMP for females than males (Betuel & Clairet, 1999; Fry et al., 1988; Fry & Rowley, 1989; Lockwood, 1988; Shoup, 1995) but these studies are limited by lack of statistical comparisons and/or poor PRMP definitions. In adults, females were more likely to report PRMP compared to males (Abreu-Ramos & Micheo, 2007; Fishbein, Middlestadt, Ottati, Straus, & Ellis, 1988; Fjellman-Wiklund & Sundelin, 1998; Fry, 1986a, 1986c; Fry, 1987; Revak, 1989; Roach, Martinez, & Anderson, 1994; Roset-Llobet et al., 2000; Yeung et al., 1999) and two times more at risk of developing PRMD (Zaza & Farewell, 1997). This trend is also documented in broader pain literature (in adults and children) and occupational health literature.

There is no clear evidence for age as a risk factor for PRMP within childhood. Studies that have considered child age merely reported descriptives (Betuel & Clairet, 1999; Dawson, 1988; Fry, 1986c; Grieco et al., 1989; Roset-Llobet et al., 2000) or overall prevalence rates (Fry & Rowley, 1989; Roset-Llobet et al., 2000). A retrospective review of 314 students aged 18 years and younger found no association between age and playing-related injuries (Burkholder & Brandfonbrener, 2004).

In adults, there is no consensus with respect to age as a risk factor for PRMP (Abreu-Ramos & Micheo, 2007; Pak & Chesky, 2001). However, there is evidence that other musculoskeletal problems such as spinal pain prevalence increase rapidly over adolescence (Balague, Dutoit, & Waldburger, 1988; Leino, Berg, & Puska, 1994; Taimela, Kujala, Salminen, & Viljanen, 1997) and

adolescent symptoms link to symptoms in adulthood (Harreby, Neergaard, Hesselsoe, & Kjer, 1995; Hertzberg, 1985; Siivola et al., 2004). Therefore it is important to identify any association between age and PRMP over childhood and adolescence.

Music exposure can be categorized into: amount (such as time spent practising) or nature of the task (such as type of instrument). These factors may be confounded by age and gender. For example, the child instrumentalist may practice for longer as they progress with their instrumental tuition over the years.

Although children's practice time has been documented, no association with PRMP has been identified (Fry et al., 1988). There are conflicting reports in adult musicians, with an association between practice time and PRMP found in some studies (Hiner, Brandt, Katz, French, & Beczkiewicz, 1987; Manchester & Flieder, 1991) but not others (Roach et al., 1994; Yeung et al., 1999).

No study has reported the relationship between the number of instruments played by a child and PRMP. Playing more than one instrument may mean an increase in the amount of time spent practicing, which may increase the risk of PRMP. Conversely, playing a different second or third instrument may add task variety (change in exposure pattern), which in the occupational health literature has been associated with a decreased risk in the development of musculoskeletal disorders (Christensen, Sogaard, Pilegaard, & Olsen, 2000; Fernstrom & Aborg, 1999; Mathiassen, 2006; Mathiassen, Moller, & Forsman, 2003).

Instrument type is consistently cited as the most significant factor affecting the prevalence of PRMP. However, only one childhood study has reported an association between instrument and PRMP. Lockwood (1988) reported PRMP in all evaluated instrument categories, with large strings (cello and bass) more associated with PRMP than small strings (violin and viola). However, they did not evaluate keyboard risk. Other small childhood studies (Dawson, 1988; Fry & Rowley, 1989) have reported prevalence rates by instrument group, but not evidence of an association between instrument type and PRMP.

Amongst tertiary music students, string, keyboard, woodwind and brass instruments have a high prevalence of problems (Fry, 1987; Pratt, Jessop, & Niemann, 1992; Zetterberg, Backlund, Karlsson, Werner, & Olsson, 1998). In adults a higher prevalence of PRMP has been reported in string (Fishbein et al., 1988; Fjellman-Wiklund & Sundelin, 1998; Newmark & Lederman, 1987; Zaza & Farewell, 1997) and keyboard players (Brandfonbrener, 2003; Fry, 1988; Hochberg, Leffert, Heller, & Merriman, 1983; Newmark & Hochberg, 1987; Roset-Llobet et al., 2000). Woodwind, brass and guitar often have lower risk, with percussion at least risk of problems (Brandfonbrener, 2003; Fishbein et al., 1988).

The majority of studies of PRMP prevalence and risk factors have been conducted on adult musicians with very limited evidence on children. To guide prevention and management, better evidence is needed to identify whether gender, age and music exposure factors are associated with PRMP in children.

Aims

Aims of this study were to:

1. establish clear prevalence data for PRMP in children and adolescents;
2. establish the univariate associations of gender, age and music exposure factors (practice time, number and type of instruments) with PRMP;
3. establish the unique associations of gender, age and music exposure factors (practice time, number and type of instruments) with PRMP after adjustment for other covariates.

Methods

Design

A cross-sectional questionnaire and anthropometric measures survey was conducted across government schools participating in the School of Instrumental Music programme. One secondary ('senior high') school with a strong instrumental programme was selected from each of the five school regions within Perth, Western Australia, to ensure a range of socioeconomic areas were represented in the sample and to ensure large instrumental numbers. One region had two schools with strong instrumental programmes and both were invited to participate. One school declined to participate due to their participation in other studies. No replacement school was invited, as the remaining school had a sufficiently large sample of instrumental students. Primary ('elementary') schools that had high instrumental numbers and were 'feeder' schools for these secondary schools were then selected. Selected schools were approached and requested to participate. The process of school selection is outlined in Figure 1.

Sample

A total of 731 students (460 females) aged between 7 and 17 years (mean 12.7 years, *SD* 2.0 years) completed the survey in August to December 2003. All instrumental classes at the selected schools were sampled. Informed assent/consent from participants and their parent or guardian was necessary for participation. There were no exclusion criteria. In the secondary schools surveyed, 201 students were sitting exams and could not complete the survey, 41 students requested to be excluded from the study and, due to the large numbers, absentees were difficult to account for. In primary schools, 21 students were not available to participate in the survey because of other school commitments, 24 requested exclusion from the study and 8 were absent.

Questionnaire and survey

A modified version of the Young people's Activity Questionnaire (YAQ-m) (Harris & Straker, 2000) was adopted for the study. It included music-specific questions and was refined through several iterations of trialing with children and parents. The survey contained general questions regarding the children's age, gender, year at school, hand dominance and general musculoskeletal complaints. The main focus of the survey was the experience of PRMS during their playing career and specifically within the past month (monthly, weekly, two to three times weekly and daily categories). Children who experienced symptoms in the last month were then asked if symptoms prevented them playing their instrument as usual (i.e., the experience of a PRMD), led them to take medication or visit health care providers. Children reported the location of their symptoms on a body diagram and rated the severity of symptoms. Other music-specific questions covered music experience and practice habits. The remaining questions covered watching television, participation in physical activities, hand intensive activities such as art, hand writing and use of computers. Children completed the questionnaire in class under the supervision of their normal teacher, and with the very young students, parents were often present for the lesson and were able to assist with the completion of the questionnaire. Questionnaires took approximately 20 minutes to complete. Height was measured using a wall-based tape measure and weight was measured using a digital scale. The first author was present to perform anthropometric measures and answer any queries.

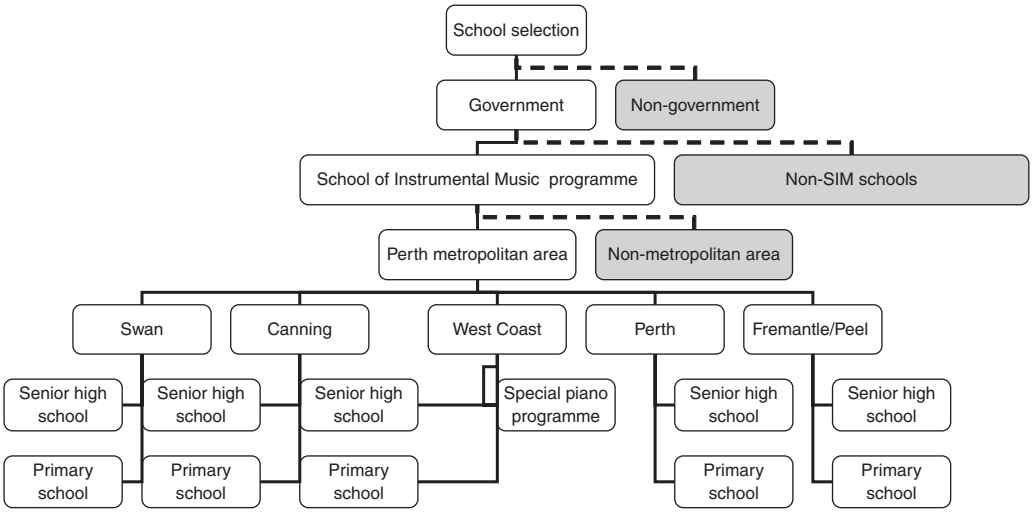

Figure 1. Method of school selection

Data analysis

Descriptive statistics are presented for life and month prevalence of PRMS and month prevalence of PRMD with prevalence rates calculated as a percentage of the whole sample. A series of univariate logistic regression analyses were performed to estimate the unadjusted effect of each independent variable for the three PRMP outcomes. Three multivariate logistic regression analyses (one for each PRMP outcome) were performed to estimate the unique effect of each independent variable after accounting for covariance between variables. Analyses were preformed using SPSS software (version 15, available from SPSS Inc.).

Results

Prevalence PRMP

A total of 489 children (67%) reported a lifetime prevalence of PRMS, and 412 children (56%) reported the experience of symptoms within the past month. A total of 219 children (30%) reported they were unable to play their instrument as usual (i.e., PRMD).

Influence of gender and age

There was a significant association observed between gender and all PRMP, with females more likely to report problems than males (unadjusted OR 1.38–1.56, see Table 3). Estimates remained similar after adjusting for age, (see Table 4). There was also a significant association observed between age and all PRMP ($p = < 0.001$, see Table 3). Estimates remained similar after adjusting for gender (see Table 4). There was no significant interaction effect between gender and age for any PRMP ($p = 0.138$–$p = 0.189$).

Influence of exposure

Practice time. Weekly practice times displayed a right-skewed distribution ranging from 17 minutes to 41 hours, with a median of 5.3 hours and an interquartile range of 4.8 hours. There was a significant association between practice time and symptoms: an increase in practice time of an hour was associated with a 5–7% increase in the odds for lifetime PRMS and monthly PRMS (see Table 3). After adjusting for other covariates, the association between practice time remained significant for MPRMS only (see Table 4).

Number of instruments played. A total of 403 (55%) children played one instrument only, with 280 (38%) playing two instruments and 48 (7%) playing three instruments, with the number of instruments played increasing with age (see Figure 2). There was no significant unadjusted association between number of instruments and any PRMP (see Table 3). In the multivariate regression model, playing three instruments in comparison to only one instrument decreased the odds for lifetime PRMS ($p = 0.023$) and monthly PRMS ($p = 0.019$) (see Table 4).

Instrument type. Piano (42%), violin (19%), clarinet (16%), guitar (15%) and flute (12%) were the most commonly played instruments (Table 1). The piano, violin and clarinet were most frequently played as the main instrument, with piano most commonly played as a second (and third) instrument.

Prevalence PRMP and instrument type

Prevalence of PRMP for instrument type and category are presented in Table 2. Piano demonstrated the lowest prevalence for all three classes of PRMP and was selected as the referent for subsequent analysis. A number of instruments showed significantly greater unadjusted odds for PRMP as compared to piano (see Table 3). The lower string category with the double bass and

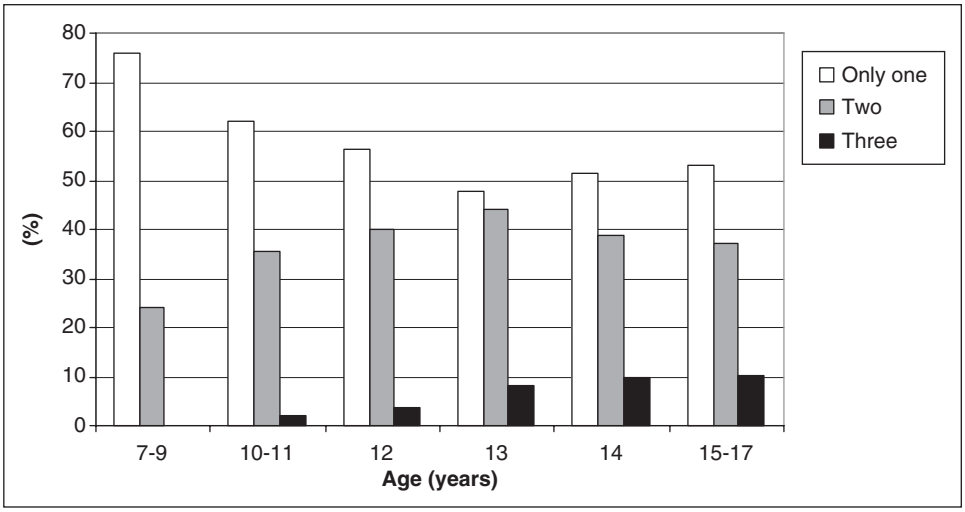

Figure 2. Percentage of children playing only one ($n = 403$), two ($n = 280$) or three ($n = 48$) instruments across age groups

Table 1. Number of children playing instruments at all and as nominated main, second and third instrument, in score order

	Played at all	Played as main instrument	Played as second instrument	Played as third instrument
Piccolo	2	–	2	–
Flute	85	61	20	4
Oboe	15	13	2	–
Clarinet	114	95	15	4
Bassoon	11	7	4	–
Saxophone	48	36	11	1
French horn	19	19	–	–
Euphonium	16	12	3	1
Baritone	4	3	1	–
Trumpet	52	41	8	3
Cornet	1	–	–	1
Trombone	32	23	7	2
Tuba	8	6	2	–
Percussion	46	22	21	3
Violin	135	113	22	–
Viola	23	18	5	–
Cello	58	50	7	1
Bass	24	18	6	–
Piano	304	130	160	14
Guitar	108	63	31	14
Harp	1	1	–	–
Other	3	–	3	–
Total	**1109**	**731**	**330**	**48**

cello, and woodwind category with saxophone and flute, demonstrated very high odds for all PRMP as compared to piano. After adjusting for other covariates, all contrasts remained significant except for the clarinet and guitar (see Table 4).

Discussion

This study found PRMP to be very common amongst children and adolescents, resulting in the inability to play as usual in a third of the study sample. Females and older children were more likely to experience problems. After adjustment for other covariates, increased practice time was associated with an increased odds of monthly PRMS, playing three instruments was associated with a reduced odds of monthly PRMS, and the odds for all PRMP were significantly different between instrument types.

Prevalence rates in this study concur with those reported in the music literature for children (Betuel & Clairet, 1999; Dawson, 1988; Fry, 1986b; Fry et al., 1988; Fry & Rowley, 1989; Lockwood, 1988; Roset-Llobet et al., 2000; Shoup, 1995) and adults (Abreu-Ramos & Micheo, 2007; H.J Fry, 1986a, 1986c; Roset-Llobet et al., 2000; Zaza, 1995; Zetterberg et al., 1998). This study is the first to establish the prevalence of symptoms and more disabling disorders amongst children and most disconcertingly shows that PRMD prevalence rates are similar to those reported by adults.

This is the first study to provide clear evidence that females are at more risk of PRMP than males in childhood. This gender risk is similar to that reported for PRMP in adult musicians (Abreu-Ramos

Table 2. Prevalence estimates and 95% confidence intervals for PRMP of instruments and instrument categories

	Lifetime Playing-Related Musculoskeletal Symptoms		Monthly Playing-Related Musculoskeletal Symptoms		Playing-Related Musculoskeletal disorders	
	Prevalence proportion	95% Confidence Interval	Prevalence proportion	95% Confidence Interval	Prevalence Proportion	95% Confidence Interval
Piano *n* = 130						
Piano *n* = 130	0.52	0.44–0.61	0.44	0.35–0.52	0.18	0.11–0.24
Upper strings *n* = 131	0.66	0.58–0.74	0.56	0.47–0.64	0.30	0.22–0.38
Violin *n* = 113	0.65	0.57–0.74	0.54	0.45–0.63	0.29	0.21–0.38
Viola *n* = 18	0.67	0.45–0.88	0.67	0.45–0.88	0.33	0.12–0.55
Lower strings *n* = 68	0.76	0.66–0.87	0.68	0.57–0.79	0.37	0.25–0.48
Cello *n* = 50	0.72	0.60–0.84	0.64	0.51–0.77	0.36	0.23–0.49
Double bass *n* = 18	0.89	0.74–1.00	0.78	0.59–0.97	0.39	0.16–0.61
Woodwind *n* = 212	0.76	0.71–0.82	0.63	0.56–0.69	0.33	0.27–0.39
Clarinet *n* = 95	0.71	0.61–0.80	0.59	0.49–0.69	0.32	0.22–0.41
Flute *n* = 61	0.79	0.68–0.89	0.62	0.50–0.74	0.33	0.21–0.45
Oboe *n* = 13	0.85	0.65–1.04	0.54	0.27–0.81	0.23	0.00–0.46
Bassoon *n* = 7	0.71	0.38–1.05	0.57	0.20–0.94	0.29	0.00–0.62
Saxophone *n* = 36	0.86	0.75–0.97	0.78	0.64–0.91	0.42	0.26–0.58
Brass *n* = 104	0.58	0.48–0.67	0.52	0.42–0.62	0.33	0.24–0.42
Trumpet *n* = 41	0.59	0.43–0.74	0.54	0.38–0.69	0.34	0.20–0.49
Trombone *n* = 23	0.65	0.46–0.85	0.52	0.32–0.73	0.30	0.12–0.49
Tuba *n* = 6	0.50	0.10–0.90	0.50	0.10–0.90	0.17	0.00–0.46
French horn *n* = 19	0.63	0.41–0.85	0.58	0.36–0.80	0.42	0.20–0.64
Euphonium *n* = 12	0.42	0.14–0.70	0.33	0.07–0.60	0.25	0.01–0.50
Baritone *n* = 3	0.33	0.00–0.87	0.67	0.13–1.00	0.33	0.00–0.87
Guitar *n* = 63						
Guitar *n* = 63	0.71	0.60–0.83	0.56	0.43–0.68	0.32	0.20–0.43
Percussion *n* = 22						
Percussion *n* = 22	0.68	0.49–0.88	0.59	0.39–0.80	0.32	0.12–0.51

Table 3. Unadjusted logistic regression odds ratio estimates (95% CI) for all independent variables for the three outcome measures of PRMP (instruments analysed both separately and as categories)

Covariate Unadjusted OR		Lifetime Playing-Related Musculoskeletal Symptoms			Monthly Playing-Related Musculoskeletal Symptoms			Playing-Related Musculoskeletal Disorders		
		Odds ratio	95% CI	*p* value	Odds ratio	95% CI	*p* value	Odds ratio	95% CI	*p* value
Gender (female)		1.38	1.01–1.89	0.046	1.56	1.15–2.11	0.004	1.46	1.04–2.04	0.028
Age (years)		1.23	1.14–1.33	<0.001	1.19	1.11–1.29	<0.001	1.19	1.08–1.29	<0.001
Total practice time (hours/week)		1.05	1.01–1.10	0.014	1.07	1.03–1.11	0.001	1.04	0.99–1.08	0.070
Number of instruments played	1	1.0			1.0			1.0		
	2	1.09	0.79–1.52	0.595	1.16	0.85–1.59	0.336	1.23	0.88–1.71	0.227
	3	0.58	0.32–1.07	0.079	0.68	0.37–1.23	0.202	0.84	0.42–1.66	0.607
Instrument										
Piano *n* = 130		1.0			1.0			1.0		
Upper strings *n* = 131		1.74	1.06–2.87	0.029	1.61	0.99–2.63	0.056	1.97	1.10–3.54	0.023
Violin *n* = 113		1.73	1.03–2.91	0.038	1.50	0.91–2.49	0.115	1.92	1.05–3.52	0.035
Viola *n* = 18		1.82	0.65–5.15	0.257	2.56	0.91–7.24	0.076	2.33	0.79–6.84	0.125
Lower strings *n* = 68		2.96	1.54–5.72	0.001	2.68	1.45–4.95	0.002	2.71	1.39–5.27	0.003
Cello *n* = 50		2.35	1.16–4.75	0.018	2.28	1.16–4.47	0.017	2.62	1.26–5.44	0.010
Double bass *n* = 18		7.29	1.61–33.01	0.010	4.48	1.40–14.36	0.012	2.96	1.04–8.45	0.043
Woodwind *n* = 212		2.95	1.85–4.72	<0.001	2.16	1.38–3.36	0.001	2.29	1.35–3.91	0.002
Clarinet *n* = 95		2.18	1.25–3.82	0.006	1.84	1.08–3.14	0.026	2.15	1.15–4.01	0.016
Flute *n* = 61		3.37	1.67–6.80	0.001	2.12	1.14–3.95	0.018	2.27	1.13–4.57	0.022
Oboe *n* = 13		5.02	1.07–23.52	0.041	1.49	0.48–4.69	0.492	1.40	0.36–5.47	0.633
Bassoon *n* = 7		2.28	0.43–12.18	0.335	1.71	0.37–7.94	0.495	1.86	0.34–10.19	0.474
Saxophone *n* = 36		5.65	2.07–15.45	0.001	4.48	1.90–10.58	0.001	3.32	1.49–7.40	0.003
Brass *n* = 104		1.24	0.74–2.09	0.411	1.38	0.82–2.32	0.219	2.26	1.23–4.15	0.009
Trumpet *n* = 41		1.29	0.63–2.62	0.486	1.48	0.73–3.00	0.273	2.41	1.10–5.30	0.028
Trombone *n* = 23		1.71	0.68–4.31	0.256	1.40	0.58–3.40	0.461	2.04	0.75–5.51	0.162
Tuba *n* = 6		0.91	0.18–4.69	0.912	1.28	0.25–6.59	0.767	0.93	0.10–8.35	0.949
French horn *n* = 19		1.56	0.579–4.22	0.378	1.76	0.67–4.67	0.255	3.38	1.23–9.35	0.019
Euphonium *n* = 12		0.65	0.20–2.16	0.483	0.64	0.18–2.23	0.484	1.55	0.40–6.18	0.534
Baritone *n* = 3		0.46	0.04–5.15	0.526	2.56	0.23–28.96	0.447	2.33	0.20–26.75	0.498
Guitar *n* = 63		2.28	1.20–4.35	0.012	1.60	0.87–2.93	0.128	2.16	1.08–4.34	0.030
Guitar *n* = 63		2.28	1.20–4.35	0.012	1.60	0.87–2.93	0.128	2.16	1.08–4.34	0.030
Percussion *n* = 22		1.95	0.75–5.11	0.172	1.85	0.74–4.63	0.189	2.17	0.80–5.92	0.130
Percussion *n* = 22		1.95	0.75–5.11	0.172	1.85	0.74–4.63	0.189	2.17	0.80–5.92	0.130

Table 4. Adjusted logistic regression odds ratio estimates (95% CI), for multivariate model including all independent variables, for the three outcome measures of PRMP (instruments analysed both separately and as categories)

Covariate Adjusted OR		Lifetime Playing-Related Musculoskeletal Symptoms			Monthly Playing-Related Musculoskeletal Symptoms			Playing-Related Musculoskeletal Disorders		
		Odds ratio	95% CI	*p* value	Odds ratio	95% CI	*p* value	Odds ratio	95% CI	*p* value
Gender (female)		1.39	0.97–2.00	0.057	1.67	1.17–2.37	0.004	1.62	1.10–2.38	0.014
Age (years)		1.22	1.10–1.35	<0.001	1.17	1.06–1.28	0.002	1.17	1.06–1.30	0.003
Total practice time (hours/ week)		1.04	0.99–1.09	0.140	1.06	1.01–1.11	0.025	1.01	0.97–1.06	0.614
Number of instruments	1	1.0			1.0			1.0		
played	2	1.02	0.70–1.49	0.916	1.01	0.76–1.53	0.66	1.26	0.87–1.81	0.222
	3	0.45	0.21–0.89	0.022	0.44	0.22–0.89	0.022	0.68	0.31–1.49	0.332
Instrument										
Piano n = 130		1.0			1.0			1.0		
Upper strings *n* = 131		2.02	1.18–3.47	0.010	1.67	0.99–2.83	0.053	1.91	1.04–3.50	0.038
Violin *n* = 113		2.13	1.20–5.42	0.009	1.62	0.93–2.80	0.087	1.94	1.03–3.67	0.041
Viola *n* = 18		1.38	0.47–4.05	0.560	1.89	0.65–5.53	0.245	1.65	0.55–4.95	0.376
Lower strings *n* = 68		3.30	1.64–6.63	0.001	2.93	1.53–5.60	0.001	2.74	1.37–5.46	0.004
Cello *n* = 50		2.55	1.20–5.42	0.015	2.39	1.17–4.87	0.017	2.61	1.22–5.57	0.013
Double bass *n* = 18		8.22	1.77–38.16	0.007	5.47	1.65–18.15	0.005	3.15	1.07–9.26	0.037
Woodwind *n* = 212		2.56	1.55–4.21	0.001	1.78	1.11–2.87	0.017	1.85	1.07–3.23	0.029
Clarinet *n* = 95		1.89	1.04–3.42	0.036	1.54	0.87–2.72	0.137	1.71	0.89–3.27	0.106
Flute *n* = 61		2.86	1.35–6.07	0.006	1.65	0.85–3.20	0.139	1.72	0.83–3.54	0.145
Oboe *n* = 13		4.28	0.89–20.37	0.068	1.22	0.38–3.92	0.737	1.09	0.27–4.33	0.903
Bassoon *n* = 7		1.37	0.25–7.54	0.719	0.99	0.21–4.81	0.995	1.14	0.20–6.39	0.882
Saxophone *n* = 36		4.83	1.71–13.65	0.003	4.01	1.63–9.86	0.002	3.11	1.35–7.18	0.008
Brass *n* = 104		1.10	0.63–1.93	0.737	1.37	0.78–2.40	0.272	2.27	1.20–4.29	0.012
Trumpet *n* = 41		1.17	0.54–2.54	0.690	1.59	0.74–3.45	0.233	2.40	1.03–5.57	0.042
Trombone *n* = 23		1.73	0.65–4.64	0.277	1.78	0.68–4.66	0.244	2.71	0.95–7.74	0.062
Tuba *n* = 6		0.44	0.06–3.03	0.406	0.62	0.09–4.35	0.632	0.78	0.08–7.74	0.832
French horn *n* = 19		1.40	0.50–3.92	0.522	1.64	0.59–4.54	0.342	3.08	1.08–8.76	0.035
Euphonium *n* = 12		0.56	0.16–1.94	0.361	0.57	0.16–2.07	0.389	1.33	0.33–5.46	0.691
Baritone *n* = 3		0.56	0.05–6.67	0.648	2.99	0.25–36.41	0.389	3.08	0.26–36.68	0.374
Guitar *n* = 63		1.97	0.99–3.89	0.051	1.41	0.74–2.69	0.292	1.78	0.86–3.72	0.122
Guitar *n* = 63		1.99	1.01–3.94	0.048	1.45	0.76–2.77	0.261	1.81	0.87–3.78	0.115
Percussion *n* = 22		1.65	0.61–4.46	0.325	1.61	0.62–4.20	0.328	1.65	0.57–4.79	0.361
Percussion *n* = 22		1.68	0.62–4.55	0.310	1.66	0.63–4.34	0.303	1.66	0.57–4.86	0.352

& Micheo, 2007; Fry, 1986a, 1986c; Zaza, 1995) and for spinal pain in adults (Andersson, Ejlertsson, Leden, & Rosenberg, 1993; Croft et al., 2001) and children (Salminen, 1984; Stahl et al., 2008; Troussier et al., 1999; Watson et al., 2002). The consistency of higher risk for a broad range of musculoskeletal disorders in females suggests there may be consistent mechanisms.

This is the first study to adequately document risk of PRMP across childhood, accounting for gender. Whilst risk increased with age, it is a concern that even very young instrumentalists are experiencing activity-limiting problems. Given that the experience of back and neck pain in adolescence appears to increase the risk of back and neck pain in adulthood (Harreby et al., 1995; Hertzberg, 1985; Siivola et al., 2004), it behooves the health professional, teacher and parent to pay attention to the reporting of PRMS in children to prevent more disabling problems in adulthood.

Practice time was associated with monthly PRMS in the multivariate model. This is consistent with an increase in hours of exposure increasing the risk of developing musculoskeletal disorders reported in the occupational literature (Blatter & Bongers, 2002; Katz et al., 2000).

Whilst no prior reports of the association between number of instruments and PRMP were found, we expected an increase in risk due to increased exposure time. This study found children who played three instruments did spend more time practising than other students and time spent practising was (independently) associated with monthly problems, yet playing three instruments was associated with a reduced risk of problems. Students in our study who played more than one instrument played different instruments (i.e., from a different instrument category), which may have had different physical task demands. Playing three instruments may therefore have provided physical variety that reduced risk. This inverse relationship has been reported in occupational health literature where variation in exposure decreased the risk for WRMSD (Christensen et al., 2000; Fernstrom & Aborg, 1999; Mathiassen, 2006; Mathiassen et al., 2003). On the basis of this study, education guidelines should encourage different instrument types be played as a second or third instrument.

This was the first study to comprehensively establish risk associations between instrument/instrument category and PRMP in child instrumentalists. In this study, piano was the most commonly played instrument as a first, second or third instrument, in line with prior reports (Betuel & Clairet, 1999; Dawson, 1988, 2001; Fry, 1987; Fry & Rowley, 1989). Interestingly, the piano was associated with least problems in our study. The piano requires left and right hand and finger movements, with the elbow and shoulder in reasonable, symmetrical postures. This may explain why it was less associated with problems. In contrast, Fry and Rowley (1989) reported piano (along with the cello) to be associated with the most problems in children. Amongst adult musicians the piano/keyboard has often been associated with a greater risk of PRMP compared to other instrument groups. At professional and tertiary levels, various practice habits may influence the development of problems such as the difficulty/type of the repertoire played, the duration of practice sessions and frequency of practice sessions. It may be that the cumulative repetitions and prolonged postures of more extensive adult playing times and less physical variation are the reason adults have more problems with piano/keyboards than children in our study.

Upper and lower string players displayed significantly higher odds than piano players for all PRMP in this study. Disparity between the child and instrument size has been postulated as a reason for increased prevalence of PRMP in child string players (Lockwood, 1988). In this study, upper and lower string players displayed significantly higher odds than piano players for PRMP, though when lower strings were contrasted to upper strings there was no significant increase in risk (OR 1.41–1.73; $p = 0.280$–0.109). In adults, string instruments in general, and bowed stringed instruments specifically, are associated with more upper limb problems than keyboard, percussion, woodwind and brass (Middlestadt & Fishbein, 1989). The degree of coordination required for very

different actions of the left and right upper limb in playing a bowed string instrument may explain why these instruments are associated with more problems (Ackerman & Adams, 2005).

Woodwind players, and saxophone players in particular, displayed significantly higher odds than piano players for all PRMP in this study. Fry and Rowley (1989) reported very high PRMP prevalence in children playing clarinet and flute, although the small sample size precluded accurate estimation of population prevalence. While appropriately sized woodwind and brass instruments are supplied through the School of Instrumental Music, the weight of the instruments on the developing musculoskeletal system may place the child at risk for developing problems. In adults, woodwind instruments were associated with PRMP but with lower risk than string instruments (Brandfonbrener, 2003; Fishbein et al., 1988). Amongst tertiary music students, woodwind instruments were a similar risk for PRMP as keyboard and string instruments (Fry, 1987; Pratt et al., 1992; Zetterberg et al., 1998).

Brass players, and trumpet players in particular, displayed significantly higher odds than piano players for PRMD in this study. Potential explanatory factors for this finding may be child–instrument size mismatch, the heavy instrument weight and the difficulty of technique required to play the trumpet. In adults, the unique physical demands required to play various brass instruments, i.e., to hold and position the instrument, produce and maintain blowing pressures and manipulate valves and/or slides, are thought to contribute to the experience of PRMP (Chesky, Devroop, & Ford, 2002).

On the basis of this study, close monitoring of children playing instruments with the highest odds of PRMP, such as cello, bass, saxophone and trumpet, is recommended. Teachers and parents need to be informed of prevention strategies for PRMP associated with these instruments.

This study has several limitations related to its design. As a cross-sectional study, the strongest evidence it can provide is of association. Using self-reported measures of PRMS and PRMD may inflate prevalence rates compared to physical examination. Whilst the current analysis has provided unique information on the prevalence of PRMS and PRMD in children and the associations with practice time, number and type of instrument played, further analysis will consider location of pain experienced. The study strengths included a large, representative sample, clear case definitions and assessment of the independent effects of age and gender.

Conclusion

Gender, age, practice time and type of instrument played were associated with the reported prevalence of playing-related musculoskeletal symptoms and disorders in children learning instrumental music. The high prevalence of both PRMS and PRMD in children warrants further evaluation of risks to inform teachers, parents and children on prevention initiatives and to prevent the development of chronic disorders in adult musicians.

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Abstracts

Troubles musculo-squelettiques (TMS) associés à la pratique musicale chez les enfants: l'influence du genre, de l'âge et de l'instrument

Troubles musculo-squelettiques (TMS) sont communs chez les musiciens adultes. L'evidence limitée disponible suggère que les TMS soient aussi commun chez les enfants et les adolescents et que les facteurs de risque doivent être similaire. Le but de cette étude est de déterminer la prévalence du TMS chez les enfants et les adolescents et leurs associations avec du genre féminin, de l'âge et de l'instrument. L'étude a investigué 731 enfants qui apprenaient un instrument (460 jeune filles) entre l'âge du 7 au 17 ans. Symptômes de longue durée, symptômes de courte durée (mensuelle) et des desordres mensualles (incapacité de jouer un instrument) ont été examinés. Régression logistique a evalué l'association indépendente parmi ces facteurs de risque avec les prévalences de TMS. Parmi les étudiants, 67% ont rapporté des symptômes de TMS pendant le dernier mois et 30 % ont raporté une incapacité de jouer de façon usuelle aussi pendants le dernier mois. Le genre féminin a montré une association significative avec TMS (OR 1,38–1,56, $p = 0{,}004$–$0{,}046$), ainsi que avec l´âge (OR 1,19–0,23, $p < 0{,}001$). Aprés avoir ajustés genre et l'âge, le type d'instrument (cordes, à vent et cuivres) a demonstré une association significative avec TMS ($p < 0{,}005$) et jouer trois instruments était protecteur vis-à-vis les symptômes mensuels (OR 0,43, $p = 0{,}05$).

La haute prévalence et l'impact incapacitant des troubles musculo-squelettiques liès à la pratique musicale sont des sujets importants pour la santé de l'enfant et de l´adolescent en ayant du genre, de l'âge et l'instrument comme des facteurs de risque à gérer.

Spielbezogene Probleme des Bewegungsapparats bei kindlichen Instrumentalisten: der Einfluss von Geschlecht, Alter und instrumentaler Belastung

Spielbezogene Erkrankungen des Bewegungsapparats (SEB) sind bei erwachsenen Musikern bekannt. Die begrenzt zugänglichen Erfahrungen legen nahe, dass SEB auch bei Kindern und Jugendlichen vorkommen und dass die Risikofaktoren ähnlich sind. Ziel der Untersuchung war es daher, die Verbreitung von SEB bei Kindern und Jugendlichen nachzuweisen und deren Verbindung mit dem weiblichen Geschlecht, mit Alter und instrumentaler Belastung zu bestimmen. Die Studie begutachtete 731 Kinder, die ein Instrument erlernen (460 weibliche Personen) im Alter von 7 bis 17 Jahren. Langzeit Symptome, monatliche Symptome und monatliche Erkrankungen (die Unfähigkeit, das Instrument wie üblich zu spielen) wurden untersucht. Logistische Regressionsanalyse bewertete die unabhängige Verbindung dieser potentiellen Risikofaktoren mit der Verbreitung von SEB.

Ergebnisse: 67% berichteten über gelegentliche SEB Symptome, 56% nannten Symptome innerhalb des letzten Monats, und 30% konnten ihr Instrument im letzten Monat nicht wie sonst spielen. Weibliches Geschlecht stand signifikant mit SEB in Verbindung (OR 1.38–1.56,

p = 0.004–0.046) wie ebenso das Alter (OR 1.19–0.23, $p < 0.001$). Nach der Eichung für Geschlecht und Alter zeigte auch die Instrumentengruppe (obere und tiefere Streicher, Holz- und Blechbläser) signifikante Zusammenhänge mit SEB ($p < 0.005$), während das Spielen von drei Instrumenten die Spieler vor monatlichen Symptomen bewahrte (OR 0.43, $p = 0.05$).

Die große Verbreitung und Beeinträchtigung des Instrumentalspiels durch SEB ist eindeutig ein wichtiger Punkt für die Gesundheit von Kindern und Jugendlichen, wobei Geschlecht, Alter und instrumentale Belastung wichtige Faktoren bei der Risikobehandlung darstellen.

Trastornos Músculo-esqueléticos Relacionados con la Interpretación en Niños Instrumentistas: Influencias del Género, Edad y Contacto con el Instrumento

Los trastornos músculo-esqueléticos relacionados con la interpretación (TMRI) son comunes entre los músicos adultos. Las evidencias limitadas de que disponemos sugieren que los TMRI son también comunes entre niños y adolescentes y los factores de riesgo pueden ser similares a los de los adultos. El propósito de este estudio fue determinar el predominio de los TMRI en niños y adolescentes y su relación con el género femenino, la edad, y el contacto con el instrumento. El trabajo encuestó a 271 niños y 460 niñas (n = 731) de entre 7 y 17 años aprendiendo a tocar un instrumento musical. Se estudiaron síntomas crónicos, síntomas mensuales y trastornos también mensuales (es decir, la incapacidad para tocar normalmente un instrumento). Mediante regresión logística se valoraron las asociaciones independientes de estos factores de riesgo potenciales con el predominio de los TMRI.

Resultados: Un 67% del alumnado dijo tener algún síntoma MRI en mayor o menor medida, un 56% dijo haber padecido algún síntoma en el último mes y un 30% informó de la imposibilidad de tocar normalmente durante el último mes. El género femenino estuvo significativamente asociado con TMRI (OR 1’38–1’56, $p = 0’004–0’046$), así como la edad (OR 1’19–0’23, $p < 0’001$). Tras realizar ajustes por género y edad, el tipo de instrumento (cuerdas superiores e inferiores, viento madera y metal) se asociaba significativamente con todos los TMRI ($p < 0’005$). Se encontró además que tocar tres instrumentos protegía contra los síntomas mensuales (OR 0’43, $p = 0’05$).

El alto predominio de los trastornos músculo-esqueléticos relacionados con la interpretación musical y su impacto incapacitante es claramente una cuestión importante para la salud de los niños y los adolescentes en donde el género, la edad y el contacto con el instrumento son factores importantes que influyen en la gestión del riesgo.