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"It is not the mountain we conquer but ourselves."

Edmund Hillary (1919 – 2008)
New Zealand explorer

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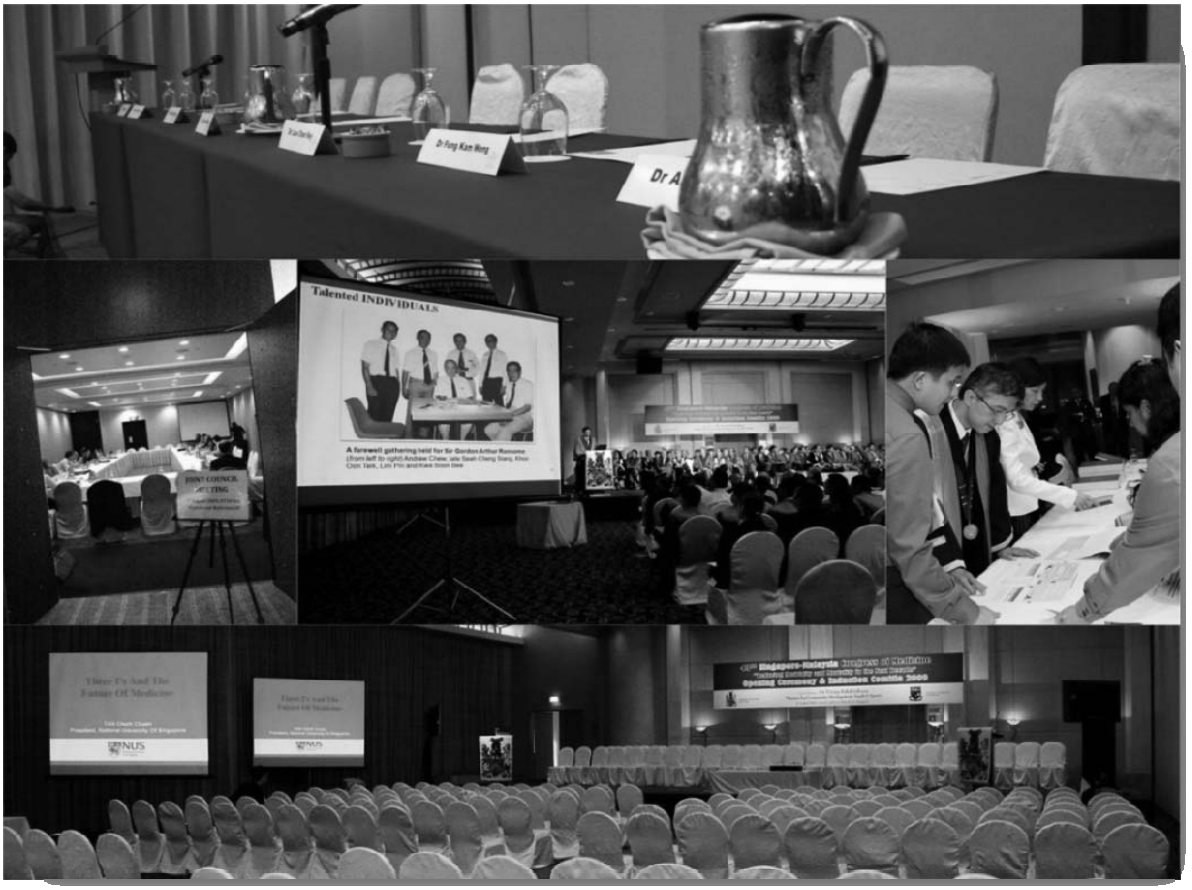

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Editorial

Social Support for Older Adults—A Bane or a Boon for their Health?

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Older, compared to younger, adults are more likely to experience physical and cognitive impairment and functional limitations, which may limit their daily activities.[1] Consequently, some may require physical assistance in basic activities (e.g. dressing, going to the toilet, cooking) or in activities that demand a higher level of autonomy (e.g. getting groceries, managing finances).[2] Even for those who do not require physical assistance, there may be reliance on financial[3] or emotional support.[4] In Singapore, as elsewhere in Asian societies, support from the family is seen as the primary source of care for older adults.[5] Societal expectations of filial piety place the responsibility of care largely on children.[6] The same is reflected in legal provisions such as the Maintenance of Parents Act, enforcing financial support from children who can provide it but choose not to.

Support from the family, as we have discussed thus far, is one type of social support, amongst others. Social support refers broadly to the resources available to a person through his/her social network members.[7] Several distinctions have been made regarding the nature of these resources. They may either be tangible (e.g. material goods, money) or intangible (e.g. information, emotional support), routine or adhoc, as well as kin-based or non kin-based. What is most important for health outcomes, however, seems to be whether the social support in question is "perceived" (i.e. the support a person perceives to be available if needed), or "received" (i.e. support actually received). Perceived social support has been consistently linked to better mental and physical health outcomes.[8] While one would intuitively expect a similar beneficial effect of received social support, its association with health outcomes is ambiguous, with several studies finding no effect, or even a detrimental effect.[8] In fact, studies have suggested that receipt of excessive support from the family may induce a sense of dependency in older adults.[9] It is thus pertinent that we focus on the nuanced links between received social support and health outcomes, since most social policy in Singapore and elsewhere is concerned with improving actual support received by older adults.

Received Social Support and Health Outcomes

Recent research suggests that whether received social support is salubrious or detrimental for health remains contingent on at least 2 main modifiers. The first key modifier is the influence of received social support on the recipient's perception of control. Bolger and Amarel[10] elucidated this mechanism among young women, showing that while receipt of social support reduced emotional reactivity to stressors, this effect was only observed when the recipient was unaware of the support being given to him/her (i.e. invisible support). Support which the recipient was aware of (i.e. visible support) was either ineffective or exacerbated emotional reactivity to stressors instead. They attributed this phenomenon to visible support often communicating a sense of inefficacy (i.e. control over an intended outcome) to recipients. Our own research, in Singapore, validated this explanation among older adults.[11] We demonstrated that while receipt of social support from the family directly reduced older adults' depressive symptoms, it simultaneously reduced their personal mastery (i.e. control over one's life). In turn, this reduction in personal mastery was associated with increased depressive symptoms, resulting in no net mental health benefit of received social support among older Singaporeans.

The second key modifier is the responsiveness of received social support to the recipient's needs. In other words, the provision of support should be appropriate to the specific physical or emotional needs of the recipient. A previous study among adults aged 18 to 73 found that the positive

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effects of received social support for mental health broke down (i.e. became weaker, absent, or negative) when there was an oversupply of support in relation to the needs of the recipient.[12] Similarly, a large survey of Europeans aged 65 and above found that the relationship between receiving instrumental support and depression varied by the severity of the recipient's physical limitation.[13] They found that while daily instrumental support increased the likelihood of depression among older adults with a medium level of physical limitation, it decreased the likelihood of depression among those who had severe physical limitations.

Future Considerations

After reading our article, support providers of older adults would likely benefit from knowing how best to respond to specific needs of their care recipients, or how best to provide support that retains one's perception of control. Unfortunately, the literature on factors and interventions addressing the "mixed blessing"[14] provided by received social support is relatively scant, especially in research among older adults. A deeper understanding of previously unexplored pathways regarding how received social support may become "too much of a good thing"[9] is needed to promote the well-being of older adults in more incisive ways. For instance, distinctive facets of received social support apart from those listed above (such as the breadth, the frequency, or the source of the support provided) may affect recipients differently.[11,13] Also, structural factors such as gender, ethnicity and socioeconomic status can further be explored, since women have been shown to be more sensitive to kin-based social support compared to men.[11,13] Lastly, most research on the mixed effect of received social support focuses on psychological health outcomes, but physical health outcomes could also be affected either directly or indirectly through psychological pathways. As a result, it is likely that the effect of received social support on health in totality has been consistently underestimated.[15]

Conclusion

Thus, is received social support a bane or a boon for health outcomes? A simple answer is that it depends—from what we know thus far, we reiterate that at least 2 considerations must be taken into account. First, received social support is a bane when it erodes the recipient's sense of control, but can be a boon if it allows retention of his or her sense of control. Second, it is a bane when it exceeds the physical or emotional needs of the recipient, but can be a boon when it is responsive or appropriate to the needs. In sum, provision of social support certainly has the potential to improve the lives of older adults, but must be wielded carefully, much like a double-edged sword.

REFERENCES

1. Verbrugge LM, Jette AM. The disablement process. Soc Sci Med 1994;38:1-14.
2. Hellström Y, Hallberg IR. Perspectives of elderly people receiving home help on health, care and quality of life. Health Soc Care Community 2001;9:61-71.
3. Verbrugge LM, Chan A. Giving help in return: family reciprocity by older Singaporeans. Ageing & Society 2008;28:5-34.
4. Alexopoulos GS. Depression in the elderly. Lancet 2005;365:1961-70.
5. Mehta KK. A critical review of Singapore's policies aimed at supporting families caring for older members. J Aging Soc Policy 2006;18:43-57.
6. Mehta KK. Stress among family caregivers of older persons in Singapore. J Cross Cult Gerontol 2006;20:319-34.
7. Song L, Son J, Lin N. Social support. In: Scott J, Carrington PJ, editors. The SAGE handbook of social network analysis. London: SAGE; 2011. p. 116-128.
8. Thoits PA. Mechanisms linking social ties and support to physical and mental health. J Health Soc Behav 2011;52:145-61.
9. Silverstein M, Chen X, Heller K. Too much of a good thing? Intergenerational social support and the psychological well-being of older parents. Journal of Marriage and Family 1996;58:970-82.
10. Bolger N, Amarel D. Effects of social support visibility on adjustment to stress: experimental evidence. J Pers Soc Psychol 2007;92:458-75.
11. Ang S, Malhotra R. Association of received social support with depressive symptoms among older males and females in Singapore: is personal mastery an inconsistent mediator? Soc Sci Med 2016;153:165-73.
12. Melrose KL, Brown GDA, Wood AM. When is received social support related to perceived support and well-being? When it is needed. Pers Individ Dif 2015;77:97-105.
13. Djundeva M, Mills M, Wittek R, Steverink N. Receiving instrumental support in late parent-child relationships and parental depression. J Gerontol B Psychol Sci Soc Sci 2015;70:981-94.
14. Gleason MEJ, Iida M, Shrout PE, Bolger N. Receiving support as a mixed blessing: evidence for dual effects of support on psychological outcomes. J Pers Soc Psychol 2008;94:824-38.
15. Umberson D, Montez JK. Social relationships and health: a flashpoint for health policy. J Health Soc Behav 2010;51:S54-S66.

Original Article

Prevalence and Correlates of Internet Gaming Problem among Internet Users: Results from an Internet Survey

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Abstract

Introduction: The current study aimed to establish the prevalence of internet gaming disorder (IGD) and its association with demographic characteristics, game genre, game use (time spent on gaming), as well as psychological distress, social phobia and well-being among current online gamers in Singapore. Materials and Methods: A total of 1251 participants aged 13 to 40 years completed the study which was administered as a web survey. The online questionnaire was designed using QuestionPro, and consisted of 8 sections and 105 questions. The 9-item Internet Gaming Disorder Questionnaire was used to establish the prevalence of IGD in the study. A series of logistic regression models were used to examine the associations between IGD, demographic characteristics and game genre, as well as IGD and psychological distress, social phobia and well-being. Results: The prevalence of IGD established using a cutoff of 5 among those who were current online gamers was 17.7%. Multiple logistic regressions revealed that those meeting criteria of IGD were more likely to be older, reported an earlier age of onset of playing online games, had primary and secondary education versus tertiary education, were currently students versus being currently employed and played massively multiplayer online role-playing games. Distress and social anxiety were higher while satisfaction with life was significantly lower among those who met criteria for IGD than those who did not meet the criteria. Conclusion: The prevalence of IGD and its negative consequences in our sample of current online gamers was significant and point towards the need for further clinical studies and innovative interventions to address the problem.

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Key words: Gamers, Massively multiplayer online role-playing games, Psychological distress

Introduction

The internet has become indispensable to societies across the world as it continually creates new ways for people to communicate, congregate, and share information. Given the multifaceted ways in which individuals can interact with the internet, there is a growing appreciation that the internet serves different purposes and that these individuals may be quite different from each other in terms of their preferred choice of online activities. Increasingly, reports have begun to focus on the preoccupation that some people develop with certain aspects of the internet, particularly online games.

Internet gaming is a booming market. In 2012, more than 1 billion individuals played computer games.[1] While most users enjoy these games and use them as a form of recreation, for some, it leads to problematic use and research has shown that under certain conditions, gaming may become psychologically, socially and/or physically detrimental to the user.[2,3] Internet gaming addiction is a behavioural problem that has been described in numerous ways. According to Griffiths,[4] biopsychosocial processes lead to the development of addictions, such as internet gaming addiction, which include the following components

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– the salience of the behaviour (preoccupation with gaming); use of the behaviour in order to modify mood (i.e. gaming is used to escape reality or create the feeling of euphoria); development of tolerance (the individual needs increasingly more time to feel the same effect); withdrawal symptoms subsequent to the discontinuation of the behaviour (the individual feels anxious, depressed, and irritable if they are prevented from playing) as well as interpersonal and intrapersonal conflict develops as a consequence of the behaviour (the individual has problems with relationships, studies, job, and hobbies). Finally, upon discontinuation of the behaviour, the individual experiences relapse (they reinitiate gaming).[4] The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) Workgroup has recommended the inclusion of internet gaming disorder (IGD) in Section III of DSM-5 as "a condition warranting more clinical research and experience before it might be considered for inclusion in the main book as a formal disorder".[5] Under the new DSM-5 framework, IGD refers to the "persistent and recurrent use of the internet to engage in games, often with other players, leading to clinically significant impairment or distress as indicated by 5 (or more) criteria in a 12-month period".[5] The diagnostic criteria include a preoccupation with gaming, withdrawal symptoms, tolerance (i.e. spending more time gaming), lack of control, loss of other interests, use despite negative consequences, deception, mood modification, and losing a relationship, job, and similarly important aspects of life.[5] A recent article by Petry et al[6] has attempted to standardise the DSM-5 internet gaming criteria and made a case for the use of structured questions with consistent wording, while ensuring that clinicians and researchers in different countries could contribute to the development and wording of these items.

Research on gaming addiction dates back to 1983,[7] however, these early studies as well as those conducted in recent years suffer from lack of comparability. Conceptualisation of internet gaming addiction, varied use of terminology (internet gaming addiction, dependence, excessive play), diverse instruments and lack of standardised diagnostic criteria have all contributed to the problem—possibly resulting in varying prevalence rates ranging from as low as 0.1% to more than 50%.[8,9] A growing number of studies indicate that internet gaming addiction is associated with various negative consequences.[2] The psychological consequences include sacrificing offline relationships, sleep, work, education and socialising,[10-17] obsession with gaming and a lack of offline face-to-face relationships,[18] lack of attention,[10,19] aggression and hostility,[19,20] stress,[10] dysfunctional coping,[10,21,22] poor academic achievement,[15,23] low well-being and loneliness.[24] Other issues identified include problems with sleeping[18,25] and seizures.[26]

The problem has reached worrying proportions in a number of Asian countries. In South Korea, internet gaming addiction is viewed as a public health concern,[27] where up to 24% of children who have been diagnosed with internet addiction are hospitalised.[28] In Japan, the government has recognised the problem following a study by the Ministry of Education, which has led to the development of "fasting camps" where individuals suffering from internet and gaming addiction are helped by being cut off from technology completely.[29] It has been stated that "the higher the internet penetration and social acceptance of gaming, the higher the prevalence of gaming problems".[30] Singapore is a sovereign city-state and island country in Southeast Asia. The country is placed highly among international rankings with regard to education, healthcare, and economic competitiveness. Singapore also has one of the highest broadband penetration rates in the world[31] where 84% of households have home internet access and almost all of such households are connected to the internet via broadband. About 97% of households with children attending school have home computer access and about 96% have home internet access. The easy access to and increasing use of internet games among Singaporean children and adolescents, contribute to public concerns regarding pathological or obsessive gaming. However, scientific evidence regarding the extent of the problem in the Singapore context is scant although anecdotal accounts of local clinicians indicate a growing problem in the clinical setting. The current study aimed to establish the prevalence of IGD using the IGD questionnaire[6] and its association with demographic characteristics, game genre, game use (time spent on gaming), as well as psychological distress, social phobia and well-being among a sample of online gamers using an internet survey.

Materials and Methods

Participants

The inclusion criteria comprised those residing in Singapore when the survey was conducted, aged between 13 to 40 years, able to read and understand English and current internet users. The study was largely targeted at adolescents and young adults (15 to 39 years)[32] who are internet savvy and consumers of internet games. To be more inclusive, the lower age limit was set at 13 years to include those who had at least completed primary school (to ensure a better understanding of the research procedures and the survey) and the upper age limit was set at 40 years.

A total of 1251 participants aged 13 to 40 years completed the study which was administered as a web survey. Fifteen records were excluded for unreliable data. The survey was launched and completed in October 2014. Two recruitment

strategies were adopted. One of the strategies was to advertise the study through printed flyers which were distributed to retail game stores. The other strategy was to create awareness by placing the flyer digitally on social media platforms and various gaming forums. Individuals who participated in the survey could share the link to the web survey with their friends and relatives using mobile messaging and emails. Individuals were asked to indicate their willingness to participate by going through an online consent form. The study was approved by the relevant institutional and ethics committees. All respondents who completed the survey were given a SGD $20 voucher as an inconvenience fee.

Procedure

The online questionnaire was opened for 4 days. The survey ended automatically when the survey quota was reached. The online questionnaire was designed using QuestionPro, an online survey tool. The web survey consisted of 8 sections and 105 questions, and took about 10 to 15 minutes to complete. The participants remained anonymous. The data collected was downloaded from QuestionPro in SPSS's data file format.

Measurements

Sociodemographic and background variables such as age, gender, average playing time during weekdays, average playing time during weekends, game genres played by participants and for how many years they had played internet games were captured. Game genres included in the questionnaire were based on the extant literature that reported on the popularity of games based on player subscriptions as well as their identification as a prominent genre in Asian settings.[33,34] These included: (i) Massively multiplayer online role-playing games (MMORPGs) which are multiplayer role-playing games (RPGs) played online over the internet wherein a large number of people simultaneously interact and play the same game. The players assume the role of a character, and development of this character by reaching "higher levels" is the primary goal of the game. These include games like 'World of Warcraft', 'Runescape' and 'MapleStory'; (ii) Real-time strategy games (RTS) which are based typically in a war setting. The participant builds structures, forms an army, manoeuvres structures and units under his control and engages in battle to destroy the opponent's assets;[35] (iii) First-person shooter games (FPS) which involve interacting with objects in a virtual world through a first-person perspective. The interactions largely comprise shooting the objects using guns and other projectile weapons.[36] These games can be played either by a single player or they can be team-based; and (iv) Others – participants were asked to report on any other type of game genres/games they had played as open text under this category.

The 9-item Internet Gaming Disorder Questionnaire[6] was used to assess IGD. The questionnaire is developed such that each item is intended to reflect a DSM-5 criterion for IGD in whole. Each question is answered as a Yes/No and relates to a period of the past 12-months, with affirmative responses to any item indicative of meeting the criterion. The proposed cut-point of 5 criteria was conservatively chosen in the DSM-5 for determining those who met criteria for IGD. The internal consistency reliability of the scale assessed by Cronbach's alpha coefficient in this sample was 0.725.

The 12-item General Health Questionnaire (GHQ-12) is a self-administered screening questionnaire, aimed at detecting individuals with a diagnosable psychiatric disorder.[37] The GHQ-12 is the most extensively used screening instrument for common mental disorders, in addition to being a more general measure of psychiatric well-being. The brevity makes it attractive for use in internet surveys. The customary scores used are a bimodal scale (0-0-1-1) which was adopted in our study. The validity of this instrument has been demonstrated in previous studies in Singapore.[38,39] The Cronbach's alpha coefficient in the current study was 0.85. We used a cutoff score of 3 and above as indicating psychological distress in our study.

The Social Phobia Inventory (SPIN)[40] is a 17-item scale for social anxiety disorder (social phobia). The items were rated over the past week and assessed each of the symptom domains of social anxiety disorder (fear, avoidance, and physiologic arousal). Each item was rated on a 5-point scale from 0 = not at all to 4 = extremely. Scores were summed to determine a total score ranging from 0 to 68. A cutoff point of 19 was used to determine the presence of social phobia. The Cronbach's alpha coefficient for SPIN in the study was 0.93.

The 5-item Satisfaction with Life Scale[41] was designed to measure global cognitive judgments of one's life satisfaction (not a measure of either positive or negative affect). Participants indicated how much they agree or disagree with each of the 5 items using a 7-point scale that ranged from 7 = strongly agree to 1 = strongly disagree. Higher scores indicate greater satisfaction with life. This scale has been validated in a previous study among Singapore college students.[42] The Cronbach's alpha coefficient in the current study was 0.89.

Statistical Analysis

Mean and standard deviations or median (if normality was not satisfied) were calculated for continuous variables, and frequencies and percentages for categorical variables.

In order to adjust for a large number of variables, a series of logistic regression models was used to examine the associations between IGD, demographic characteristics and game genre, as well as IGD and psychological distress, social phobia and well-being. First regression models were run separately for each specific online game played and IGD; the final model included all sociodemographic variables and controlled for other games. Similarly, regression models were first run for psychological distress, social phobia and well-being (adjusted for sociodemographic variables) and IGD. Subsequently, the final model was run for psychological distress, social phobia and well-being, adjusted for sociodemographic variables as well other scales. Statistical significance was evaluated at the <0.05 level using two-sided tests. All statistical analyses were carried out using the Statistical Analysis Software (SAS) System version 9.[43]

Results

The sociodemographic characteristics of the study sample are shown in Table 1. All further analyses were conducted on those who indicated that they played online games currently.

The most popular games played by current gamers were 'Counterstrike' (47.2%) followed by 'MapleStory' (45.2%) and 'Defense of the Ancients (DotA) 2' (39.5%). The prevalence of IGD established by using a cutoff of 5 among current online gamers was 17.7% (n = 172/972). Among current online gamers, there were significant differences in game playing frequency in terms of days in a week, hours during weekdays and hours on weekends between those who met DSM-5 criteria for IGD and those who did not. The duration of play in terms of mean days in a week (5.0 vs 3.8, P <0.001), and mean hours during weekdays (4.1 vs 3.0, P <0.001) and weekends (6.5 vs 4.5, P <0.001) were

Table 1. Sociodemographic Characteristics of the Overall Sample and of Current Online Gamers

Variable		Sample n = 1236		Current Online Gamers n = 972	
		Mean	SD	Mean	SD
Age		23.7	5.3	23.6	5.0
		n	%	n	%
Sex	Female	550	44.5	358	36.8
	Male	686	55.5	614	63.2
Nationality	Singapore citizen	1172	94.8	926	95.3
	Permanent resident	64	5.2	46	4.7
Ethnic group	Chinese	1153	93.3	903	92.9
	Malay	52	4.2	42	4.3
	Indian	23	1.9	20	2.1
	Others	8	0.7	7	0.7
Education level (completed)	Primary	29	2.4	24	2.5
	Secondary	28	2.3	19	2.0
	'O'*/'N'† level	209	16.9	167	17.2
	'A'‡ level	191	15.5	134	13.8
	ITE	28	2.3	28	2.9
	Polytechnic and other diplomas	345	27.9	279	28.7
	University	406	32.9	321	33.0
Employment	Student	636	51.5	496	51.0
	Employed	543	43.9	436	44.9
	Unemployed	45	3.6	35	3.6
	Housewife/husband	12	1.0	5	0.5
Ever played internet games?	Never	150	12.1		
	Yes	1085	87.9		

ITE: Institute of Technical Education
*Equivalent to Grade 10.
†Exams taken after 4 years of secondary education.
‡Equivalent to Grade 12.

significantly higher among those who met criteria for IGD than those without IGD.

Multiple logistic regressions revealed that those who met criteria for IGD were more likely to be older, had an earlier age of onset of play, with primary and secondary education, were currently students and played MMORPGs (Table 2). Multiple logistic regression with adjustment for demographic characteristics revealed that those who play 'World of Warcraft' remained significantly associated with meeting IGD criteria (Table 3). Figures 1 and 2 show the relationship between IGD, GHQ-12 and SPIN. After adjusting for sociodemographic characteristics and the score in other scales, these relationships remained significant throughout the regression models (Table 4).

Discussion

The prevalence of IGD among a sample of online gamers was 17.7%. A previous study from Singapore reported that 17.1% of adolescents reported "excessive use" of the internet, where excessive use was defined as internet use of more than 5 hours a day.[44] Yen et al[45] have suggested that sociocultural differences might partly account for the higher prevalence of internet addiction in some Asian countries than in the United States.[9] The authors proposed that in Asian countries where academic success is highly sought after, and adolescent face strong competition in the school environment, the "internet provides a virtual world in which they can temporarily forget the stress of academic performance". These influences may partly explain the high prevalence of IGD among current online gamers in Singapore.

Table 2. Sociodemographic Correlates of Internet Gaming Disorder

Variable		IGD				Multiple Logistic Regression			
		No		Yes					
		n	%	n	%	OR	95% CI		*P* Value*
Age	Mean (SD)	23.5	4.9	24.0	5.6	1.1	1.1	1.2	<0.0001
Age of onset	Mean (SD)	13.5	4.2	13.2	3.8	0.9	0.9	1.0	0.017
Sex	Female	300	83.8	58	16.2	Ref.			
	Male	500	81.4	114	18.6	1.0	0.7	1.5	0.965
Nationality	Singapore citizen	763	82.4	163	17.6	Ref.			
	Permanent resident	37	80.4	9	19.6	1.3	0.6	2.9	0.502
Ethnic group	Chinese	741	82.1	162	17.9	Ref.			
	Malay	35	83.3	7	16.7	0.9	0.2	3.2	0.830
	Indian	17	85	3	15	1.0	0.4	2.5	0.929
	Others	7	100	0	0				
Education level (completed)	University	265	82.6	56	17.4	Ref.			
	Primary	16	66.7	8	33.3	3.4	1.2	9.4	0.019
	Secondary	12	63.2	7	36.8	4.3	1.5	12.4	0.008
	'O'†/'N'‡ level	133	79.6	34	20.4	1.3	0.8	2.3	0.301
	'A'§ level	115	85.8	19	14.2	0.8	0.4	1.5	0.498
	ITE	23	82.1	5	17.9	1.1	0.4	3.0	0.910
	Polytechnic and other diplomas	236	84.6	43	15.4	0.9	0.6	1.4	0.606
Employment	Unemployed	30	85.7	5	14.3	Ref.			
	Student	404	81.5	92	18.5	1.8	1.1	2.9	0.028
	Employed	362	83	74	17	0.9	0.3	2.6	0.889
	Housewife/husband	4	80	1	20	1.0	0.1	10.4	0.973
Type of game played‖	MMORPG	540	79.9	136	20.1	1.6	1.0	2.4	0.032
	MOBA	431	80.3	106	19.7	1.3	0.8	1.9	0.243
	FPS	530	81.8	118	18.2	0.9	0.6	1.4	0.797

FPS: First-person shooter; IGD: Internet gaming disorder; ITE: Institute of Technical Education; MMORPG: Massively multiplayer online role-playing games; RTS\MOBA: Real time strategy/multiplayer online battle arena

*<0.05 significant.

†Equivalent to Grade 10.

‡Exams taken after 4 years of secondary education.

§Equivalent to Grade 12.

‖ Multiple logistic regression adjusting for sociodemographic characteristics.

Table 3. Specific Online Games Played by Respondents and Associations with Internet Gaming Disorder

	Current Gamers (n = 972)		IGD (n = 172)		Multiple Logistic Regression Adjusting for Sociodemographic Characteristics				Multiple Logistic Regression Adjusting for Sociodemographic Characteristics and Other Games			
	Yes		Yes									
	n	%	n	%	OR	95% CI		*P* Value	OR	95% CI		*P* Value
a) Massively multiplayer online games role-playing games (MMORPG)												
1) Runescape	184	18.9	38	22.1	1.3	0.9	2.0	0.168	1.2	0.7	1.8	0.545
2) Eve	10	1	4	2.3	3.1	0.9	11.5	0.086	2.6	0.7	10.5	0.173
3) World of Warcraft	184	18.9	43	25	1.6	1.0	2.4	0.031	1.6	1.0	2.5	0.040
4) MapleStory	439	45.2	87	50.6	1.4	1.0	2.0	0.074	1.3	0.9	2.0	0.139
5) Guild Wars 2	107	11	22	12.8	1.2	0.7	2.0	0.549	1.0	0.6	1.9	0.939
6) Star Wars: The Old Republic	37	3.8	7	4.1	0.9	0.4	2.3	0.900	0.8	0.3	2.1	0.643
7) Elder Scrolls Online	51	5.2	8	4.7	0.8	0.4	1.8	0.634	0.7	0.3	1.7	0.432
8) Others	193	19.9	33	19.2	0.9	0.6	1.3	0.469	0.9	0.5	1.4	0.522
b) Real-time strategy (RTS)/ multiplayer online battle arena (MOBA)												
1) Defense of the Ancients (DotA) 2	384	39.5	75	43.6	1.3	0.9	1.9	0.160	1.1	0.7	1.7	0.593
2) Star Craft 2	147	15.1	27	15.7	1.0	0.7	1.7	0.869	0.9	0.6	1.5	0.792
3) Others	138	14.2	24	14	0.9	0.6	1.5	0.765	0.9	0.5	1.5	0.714
c) First-person shooter (FPS)												
1) Counterstrike	459	47.2	85	49.4	1.1	0.8	1.6	0.485	1.0	0.7	1.5	0.900
2) Call of Duty: Ghosts	153	15.7	26	15.1	0.9	0.5	1.4	0.595	0.8	0.4	1.3	0.291
3) Team Fortress 2	188	19.3	30	17.4	0.8	0.5	1.3	0.443	0.7	0.4	1.2	0.172
4) Battlefield 4	199	20.5	37	21.5	1.0	0.7	1.6	0.879	1.0	0.6	1.6	0.954
5) Blacklight: Retribution	33	3.4	10	5.8	1.7	0.8	3.9	0.187	2.0	0.8	5.0	0.139
6) Others	133	13.7	23	13.4	1.0	0.6	1.6	0.883	1.1	0.7	2.0	0.656
d) Others	193	19.9	25	14.5	0.7	0.4	1.0	0.077	0.7	0.4	1.1	0.128

Comparison across studies is difficult as questionnaires as well as sampling methodologies vary widely. A study from France using a modified Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition-Text Revision (DSM-IV-TR) substance dependence adapted scale reported that among MMORPG players, 27.5% of subjects screened met addiction criteria to MMORPGs.[46] A study from Hungary on 5045 secondary school students using the Problematic Online Gaming Questionnaire Short-Form (POGQ-SF), and latent class analysis revealed 8.2% of gamers (4.6% of total sample) belonged to the high risk group.[47] While Festl et al[8] measured problematic game use with the Gaming Addiction Short Scale (GAS) on 580 adolescents, 1866 younger and 1936 older adults (overall n = 4382) and reported that 3.7% of the respondents could be considered problematic users, the percentage of problematic gamers among adolescents was higher at 7.6%. Using random cluster sampling and the GAS in a sample of 920 participants recruited from 4 secondary schools in different districts of Hong Kong, Wang et al[48] found the prevalence of gaming addiction to be 13%.

Increasing age was a significant risk factor for IGD. The mean age of those with IGD was 24.1 years in our sample, while that of the overall sample was 23.7 years. It has been pointed out that computer games are no longer aimed at the adolescent audience[49] but also at adults. Our study also highlights the need to examine IGD not just in school-based population but also among those in institutions of higher learning as well as young working adults. Age of onset was another important factor associated with IGD with those initiating play at an earlier age showing a significant

Table 4. Relationship between Internet Gaming Disorder and GHQ-12, SPIN and SWLS Scores among Current Online Gamers

	IGD				Multivariate Logistic Regression Adjusting for Sociodemographic Characteristics				Multivariate Logistic Regression Adjusting for Sociodemographics Characteristics and Other Variables*			
	No		Yes									
	n	%	n	%	OR	95% CI		*P* Value	OR	95% CI		*P* Value
GHQ-12 cutoff score 3+	142	18.3	77	47.8	4.6	3.1	6.7	<0.001	3.4	2.2	5.4	<0.001
SPIN cutoff point of 19+	240	33.1	81	56.3	2.7	1.9	4.0	<0.001	2.0	1.3	3.2	<0.001
	Mean	SD	Mean	SD								
SWLS total score	21.2	6.9	18.5	6.5	0.95	0.92	0.97	<0.001	0.97	0.94	0.998	0.038

GHQ-12: General Health Questionnaire-12; SPIN: Social Phobia Inventory; SWLS: Satisfaction with Life Scale
*Adjusted for any 2—GHQ-12, SPIN and SWLS scores as applicable.

association with IGD. Our findings are similar to that of Achab et al[46] who reported that a young age of online gaming onset was a stronger variable associated with MMORPG addiction compared to the number of years of play.

MMORPGs mix the genres of role-playing video games and massively multiplayer online games, involving a large number of players in a virtual environment interacting via 'Avatars' with each other.[16] Playing MMORPGs was a significant predictor of IGD after adjusting for sociodemographic factors in our study. Our results are similar to that reported by others. In a sample of 696 MMORPG players, achievement, socialising, and escapism motivations were found to be predictive of addictive play, and together with gender accounted for 19% of variance in the MMORPG addiction score.[50] In a sample of 175 primarily Dutch MMORPG players, escapism and game mechanics predicted excessive gaming over and above the contribution of the time spent gaming, together explaining 46% of the variance in problematic gaming.[51] It has been suggested that the social, multiplayer nature of the game may increase the desire to play or there might be an element of peer pressure that leads to continued playing among MMORPG players.[8] Structural game characteristics such as positive reinforcements within the game may also support and encourage problematic behaviour in MMORPG play.[52]

While, overall the most popular game was 'Counterstrike', the most popular MMORPG in this sample was 'MapleStory', which currently has over 11 million account holders worldwide.[53] However, adjusting for demographic characteristics and other games played revealed that only those who played 'World of Warcraft' were consistently associated with IGD, however, we are unable to explain this finding.

Distress as measured by GHQ-12 and social anxiety as measured by SPIN were higher while the mean score on satisfaction with life scale were significantly lower among those who met criteria for IGD. As compared to those who did not meet criteria for IGD, more than twice of those meeting IGD criteria expressed significant distress (GHQ ≥3). A growing number of studies indicate that internet

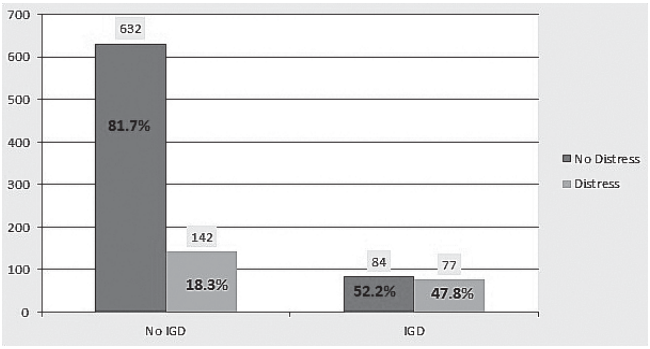

Fig.1. Graph showing psychological distress as measured by GHQ-12 among those respondents with IGD versus those without IGD. IGD: Internet gaming disorder; GHQ-12: General Health Questionnaire-12. GHQ-12 cutoff scores of 3 and more signify distress. *P* <0.001.

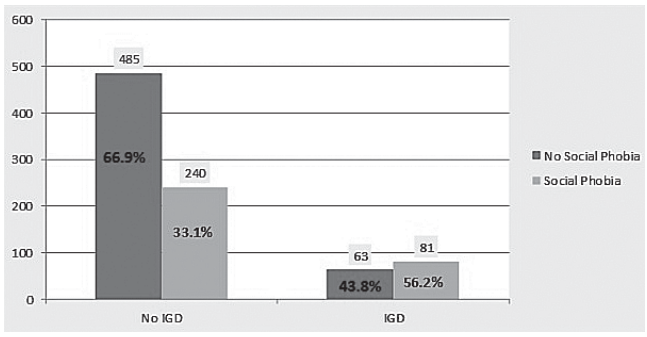

Fig. 2. Graph showing social phobia as measured by SPIN among those respondents with IGD versus those without IGD. IGD: Internet gaming disorder; SPIN: Social Phobia Inventory. SPIN cutoff scores of 19 and above are indicative of social phobia. *P* <0.001.

gaming addiction is associated with various negative consequences. Wei et al[54] reported a positive correlation between online gaming hours and depressive symptoms in their internet-based study among 722 online gamers in Taiwan. Wenzel et al[55] similarly found a high prevalence of self-reported depression and anxiety with increasing playing time among Norwegian adults. A longitudinal study by Seay et al[56] suggests that low psychological well-being results in game addiction, and not vice versa. The authors postulate that with increasing severity of depression, the self-regulatory processes are blunted and they become less effective in preventing problematic use. Thus, while depression is not a necessary precursor of problematic use, they suggest its presence may catalyse and accelerate the development of problematic use.

Our study also found that the majority of those who met the criteria for IGD also met the criteria for social phobia as assessed by SPIN (56.2%). A cross-sectional study by Lo et al[57] reported significant differences in degree of social anxiety among the heavy, light, and non-players of online games, with heavy players experiencing significantly higher levels of social anxiety compared to both light and non-players. Several researchers have suggested that social interaction in online games particularly appeals to people who are socially unskilled; who may not have an active social life in their offline lives; and feel anxious over establishing real-life interpersonal relationships.[58,59]

Festl et al[8] examined the implications of problematic game use on psychosocial well-being; their data showed a significant negative relationship between life satisfaction and problematic game use. Lemmens et al[60] similarly found a negative correlation between scores on the Game Addiction Scale (GAS) and life satisfaction. A panel study by Lemmens et al[61] similarly suggests that social competence, self-esteem, and loneliness were significant predictors of pathological gaming 6 months later.

The strengths of the study include the relatively large sample size, the first use of the IGD diagnostic scale based on DSM-5 and the collection of data that was largely complete (overall missing data was less than 2.5%) and verification of unique internet protocol (IP) addresses by the data manager. The results of the study must however, be considered in view of some of the limitations to the study. The sample was self-selected which might affect generalisability of the findings. It is possible that heavy gamers may not have participated as they may have felt that the study was stigmatising and casual gamers may have felt that the study does not apply to them though the flyers advertising the study clearly indicated that both gamers with different habits and non-gamers could participate in the study. All measures were self-reported and were not verified by a trained clinician. Although an online, anonymous survey format may facilitate greater self-disclosure, the self-administered nature of the questionnaire is less robust than directed interviewing. Self-administered online questionnaires have been used in other studies in these fields and have been described as a satisfactory method.[16] Research has also indicated that self-diagnosis correlates with standardised measures of addiction, suggesting that the individual's perception of problems can be relatively accurate.[62] The IGD measure is yet to be clinically validated in Singapore's population. Thus, it is possible that there are false positives leading to a higher than true prevalence rate.

It must also be pointed out that the pathophysiology of IGD remains contentious. The concept of IGD could evolve in the future as researchers have argued the need for a deeper consideration of the developmental, social and cognitive processes involved in internet gaming.[63,64] Researchers have also suggested that gaming does not always occur online, and to encompass both online and offline gaming they propose the use of 'video-gaming disorder'[65] as an alternative to IGD. Future research is thus needed to understand the phenomenon better and studies must be conducted using random samples to establish the clinical validity and true prevalence of the disorder in the population.

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REFERENCES

1. PC Gaming Alliance. PC Gaming Alliance releases two member-exclusive reports covering all aspects of the still-dominant PC gaming industry 2013. Available at: http://pcgamingalliance.org/press/entry/pc-gaming-alliance-releases-two-member-exclusive-reports-covering-pc-gaming. Accessed on 5 April 2014.
2. Kuss DJ, Griffiths MD. Internet Gaming Addiction: A Systematic Review of Empirical Research. Inter J Ment Health Addiction 2012;10:278-96.
3. Kuss DJ. Internet gaming addiction: current perspectives. Psychol Res Behav Manag 2013;6:125-37.
4. Griffiths MD. A "components" model of addiction within a biopsychosocial framework. J Subst Use 2005;10:191-7.
5. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders Fifth Edition (DSM-5). Arlington, VA: American Psychiatric Association, 2013. p. 795-798.
6. Petry NM, Rehbein F, Gentile DA, Lemmens JS, Rumpf HJ, Mößle T, et al. An international consensus for assessing internet gaming disorder using the new DSM-5 approach. Addiction 2014;109:1399-406.
7. Soper WB, Miller MJ. Junk time junkies: an emerging addiction among students. School Counsellor 1983;31:40-3.

8. Festl R, Scharkow M, Quandt T. Problematic computer game use among adolescents, younger and older adults. Addiction 2013;108:592-9.
9. Zhang L, Amos C, McDowell WC. A comparative study of Internet addiction between the United States and China. Cyberpsychol Behav 2008;11:727-9.
10. Batthyány D, Müller KW, Benker F, Wölfling K. Computer game playing: clinical characteristics of dependence and abuse among adolescents. Wien Klin Wochenschr 2009;121:502-9.
11. King DL, Delfabbro P. Understanding and assisting excessive players of video games: a community psychology perspective. Aust Community Psychol 2009;21:62-74.
12. Liu M, Peng W. Cognitive and psychological predictors of the negative outcomes associated with playing MMOGs (massively multiplayer online games). Comput Human Behav 2009;25:1306-11.
13. Peng W, Liu M. Online gaming dependency: a preliminary study in China. Cyberpsychol Behav Soc Netw 2010;13:329-33.
14. Peters CS, Malesky LA. Problematic usage among highly-engaged players of massively multiplayer online role playing games. Cyberpsychol Behav 2008;11:480-3.
15. Rehbein F, Kleimann M, Mößle T. Prevalence and risk factors of video game dependency in adolescence: results of a German nationwide survey. Cyberpsychol Behav Soc Netw 2010;13:269-77.
16. Yee N. The psychology of MMORPGs: emotional investment, motivations, relationship formation, and problematic usage. In: Schroeder R, Axelsson A, editors. Avatars at Work and Play: Collaboration and Interaction in Shared Virtual Environments. London, UK: Springer-Verlag, 2006. p. 187-207.
17. Yee N. The demographics, motivations and derived experiences of users of massively-multi-user online graphical environments. PRESENCE: Teleoperators and Virtual Environments 2006;15:309-29.
18. Allison SE, von Wahlde L, Shockley T, Gabbard GO. The development of the self in the era of the Internet and role-playing fantasy games. Am J Psychiatry 2006;163:381-5.
19. Chan PA, Rabinowitz T. A cross-sectional analysis of video games and attention deficit hyperactivity disorder symptoms in adolescents. Ann Gen Psychiatry 2006;5:16-26.
20. Chiu SI, Lee JZ, Huang DH. Video game addiction in children and teenagers in Taiwan. Cyberpsychol Behav 2004;7:571-81.
21. Hussain Z, Griffiths MD. Excessive use of massively-multi-player online role-playing games: a pilot study. Int J Ment Health Addict 2009;7:563-71.
22. Hussain Z, Griffiths MD. The attitudes, feelings, and experiences of online gamers: a qualitative analysis. Cyberpsychol Behav 2009;12:747-53.
23. Jeong EJ, Kim DW. Social activities, self-efficacy, game attitudes, and game addiction. Cyberpsychol Behav Soc Netw 2011;14:213-21.
24. Lemmens JS, Valkenburg PM, Peter J. Psychosocial causes and consequences of pathological gaming. Vol Comput Human Behav 2011;27:144-52.
25. Dworak M, Schierl T, Bruns T, Struder HK. Impact of singular excessive computer game and television exposure on sleep patterns and memory performance of school-aged children. Pediatrics 2007;120:978-85.
26. Chuang YC. Massively multiplayer online role-playing game-induced seizures: a neglected health problem in internet addiction. Cyberpsychol Behav 2006;9:451-6.
27. Starcevic V. Is Internet addiction a useful concept? Aust N Z J Psychiatry 2012;47:16-9.
28. Ahn DH. Korean policy on treatment and rehabilitation for adolescents' internet addiction. In: Commission NY, editor. 2007 International Symposium on the Counseling and Treatment of Youth Internet Addiction. Seoul, Korea: National Youth Commission; 2007. p. 49.
29. Majumdar A. Japan plans 'fasting camps' for Web-addicted children. Tech 2. 2013. Available at: http://tech2.in.com/news/general/japan-plans-fasting-camps-for-webaddicted-children/912284. Accessed on September 2, 2013.
30. King DL, Delfabbro PH, Griffiths MD. Clinical interventions for technology-based problems: excessive Internet and video game use. J Cogn Psychother 2012;26:43-56.
31. IDA Singapore. Annual survey on infocomm usage in households and by individuals for 2012. Available at: https://www.ida.gov.sg/~/media/Files/Infocomm%20Landscape/Facts%20and%20Figures/SurveyReport/2012/2012HHmgt.pdf. Accessed on 31 March 2016.
32. Geiger AM, Castellino SM. Delineating the age ranges used to define adolescents and young adults. J Clin Oncol 2011;29:e492-3.
33. Chen KT, Huang P, Lei CL. Game traffic analysis: An MMORPG perspective. Computer Networks 2006;50:3002-23.
34. Achterbosch L, Pierce R, Simmons G. Massively multiplayer online role-playing games: the past, present, and future. ACM Comput Entertain 2008;5:Article 9. Available at: http://doi.acm.org/10.1145/1324198.1324207. Accessed on 31 March 2016.
35. Hagelbäck J. Multi-agent potential field based architectures for real-time strategy game bots. PhD thesis. Karlskrona, Blekinge, Sweden: Blekinge Institute of Technology, 2012. Available at: https://www.diva-portal.org/smash/get/diva2:805274/FULLTEXT01.pdf. Accessed on 6 September 2015.
36. Isokoski P, Martin B. Eye tracker input in first person shooter games. In: Proceedings of COGAIN 2006: Gazing into the Future, 78-81. Available at: http://www.cogain.org/cogain2006/COGAIN2006_Proceedings.pdf. Accessed on 31 March 2016.
37. Goldberg DP, Hillier VF. A scaled version of the General Health Questionnaire. Psychol Med 1979;9:139-45.
38. Boey KW. Distressed and stress resistant nurses. Issues Ment Health Nurs 1999;20:33-54.
39. Lim L, Ng TP, Chua HC, Chiam PC, Won V, Lee T, et al. Generalised anxiety disorder in Singapore: prevalence, co-morbidity and risk factors in a multi-ethnic population. Soc Psychiatry Psychiatr Epidemiol 2005;40:972-9.
40. Connor KM, Davidson JR, Churchill LE, Sherwood A, Foa E, Weisler RH. Psychometric properties of the social phobia inventory. Br J Psychiatry 2000;176:379-86.
41. Diener E, Emmons RA, Larsen RJ, Griffin S. The satisfaction with life scale. J Pers Assess 1985;49:71-5.
42. Diener E, Scollon CN, Oishi S, Dzokoto V, Suh EM. Positivity and the construction of life satisfaction judgments: global happiness is not the sum of its parts. J Happiness Stud 2000;1:159-76.
43. SAS Institute Inc. SAS/STATA 9.2 User's Guide: Introduction to Survey Sampling and Analysis Procedures. Book Excerpt. Cary, NC: SAS Institute Inc, 2008.
44. Subramaniam M, Qiu S, Winslow M. Prevalence and correlates of excessive Internet use among youth in Singapore. Ann Acad Med Singapore 2008;37:9-14.
45. Yen CF, Yen JY, Ko CH. Internet addiction: ongoing research in Asia. World Psychiatry 2010;9:97.
46. Achab S, Nicolier M, Mauny F, Monnin J, Trojak B, Vandel P, et al. Massively multiplayer online role-playing games: comparing characteristics of addict vs non-addict online recruited gamers in a French adult population. BMC Psychiatry 2011;11:144.
47. Pápay O, Urbán R, Griffiths MD, Nagygyörgy K, Farkas J, Kökönyei G, et al. Psychometric Properties of the Problematic Online Gaming Questionnaire Short-Form and Prevalence of Problematic Online Gaming in a National Sample of Adolescents. Cyberpsychol Behav Soc Netw 2013;16:340-8.

48. Wang CW, Ho RT, Chan CL, Tse S. Exploring Personality Characteristics of Chinese Adolescents with Internet-Related Addictive Behaviors: Trait Differences for Gaming Addiction and Social Networking Addiction. Addict Behav 2015;42:32-5.
49. Griffiths MD, Davies MNO, Chappell D. Breaking the stereotype: the case of online gaming. CyberPsychol Behav 2003;6:81-91.
50. Zanetta DF, Zermatten A, Billieux J, Thorens G, Bondolfi G, Zullino D, et al. Motivations to play specifically predict excessive involvement in massively multiplayer online role-playing games: evidence from an online survey. Eur Addict Res 2011;17:185-9.
51. Kuss DJ, Louws J, Wiers RWW. Online gaming addiction? Motives pre¬dict addictive play behavior in massively multiplayer online role-playing games. Cyberpsychol Behav Soc Netw 2012;15:480-5.
52. Chumbley J, Griffiths M. Affect and the computer game player: the effect of gender, personality, and game reinforcement structure on affective responses to computer gameplay. Cyberpsychol Behav 2006;9:308-16.
53. Maple Story. Available at: http://maplestory.nexon.net/landing. Accessed on 12 November 2014.
54. Wei HT, Chen MH, Huang PC, Bai YM. The association between online gaming, social phobia, and depression: an internet survey. BMC Psychiatry 2012;12:92.
55. Wenzel HG, Bakken IJ, Johansson A, Götestam KG, Øren A. Excessive computer game playing among Norwegian adults: self-reported consequences of playing and association with mental health problems. Psychol Rep 2009;105:1237-47.
56. Seay AF, Jerome WJ, Lee KS, Kraut RE. Project Massive: A Study of Online Gaming Communities. Proceedings of the CHI 2004 Conference on Human Factors in Computing Systems, Vienna, Austria, 24-29 April, 2004. Available at: http://social.cs.uiuc.edu/class/cs598kgk-04/papers/p1421-seay.pdf. Accessed on 7 April 2016.
57. Lo S, Wang C, Fang W. Physical interpersonal relationships and social anxiety among online game players. Cyberpsychol Behav 2005;8:15-20.
58. Chak K, Leung L. Shyness and locus of control as predictors of Internet addiction and Internet use. Cyberpsychol Behav 2004;7:559-70.
59. Peters CS, Malesky LA. Problematic usage among highly-engaged players of massively multiplayer online role playing games. Cyberpsychol Behav 2009;11:481-3.
60. Lemmens JS, Valkenburg PM, Peter J. Development and validation of a game addiction scale for adolescents. Media Psychology 2009;12:77-95.
61. Lemmens JS, Valkenburg PM, Peter J. Psychosocial causes and consequences of pathological gaming. Comput Human Behav 2011;27:144-52.
62. Widyanto L, Griffiths MD, Brunsden VA. Psychometric comparison of the Internet Addiction Test, the Internet-Related Problem Scale, and self-diagnosis. Cyberpsychol Behav Soc Netw 2011;14:141-9.
63. Allison SE, von Wahlde L, Shockley T, Gabbard GO. The development of the self in the era of the internet and role-playing fantasy games. Am J Psychiatry 2006;163:381-5.
64. King DL, Delfabbro PH. The cognitive psychology of Internet gaming disorder. Clin Psychol Rev 2014;34:298-308.
65. King DL, Delfabbro PH. Issues for DSM-5: video-gaming disorder? Aust N Z J Psychiatry 2013;47:20-2.

Original Article

Prevalence of Tobacco Smoking and Accuracy of Self-Reporting in Pregnant Women at a Public Hospital for Women and Children

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Abstract

Introduction: Denial of smoking status by pregnant women presents a missed opportunity for referral to smoking cessation programmes that are shown to be effective in helping them quit smoking. Materials and Methods: A cross-sectional epidemiological survey was conducted to detect the true prevalence of active smoking pregnant patients and the accuracy of self-reporting, investigate the sociodemographic risk factors and test the knowledge of pregnant patients on adverse effects of smoking. This involved 972 antenatal patients of a maternity hospital where participants completed a sociodemographic data survey and answered a knowledge questionnaire. Urine cotinine testing was carried out after informed consent. Results: The prevalence of active smokers was 5.2% (n = 50) with 3% (n = 29) being light smokers and 2.2% (n = 21) being heavy smokers. This was significantly higher than self-reported active smoking status of 3.7% (n = 36; *P* = 0.02). The Malay race, being aged less than 20 years and not having tertiary level qualifications independently increased the likelihood of being an active smoker. Knowledge of the adverse effects of smoking was generally good with a mean total score of 8.18 out of 10 but there were differences amongst the non-smokers, passive smokers, light smokers and active smokers (*P* = 0.012). Conclusion: While the prevalence of active smoking among pregnant women is low in Singapore compared to other countries, this study substantiated the unreliability of self-reporting of smoking status in the pregnant population which could complicate referral to smoking cessation programmes. The lower awareness of the harms of smoking during pregnancy among smokers highlights a potential area for improvement.

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Key words: Pregnancy, Reproducibility of results, Truth disclosure, Urine cotinine

Introduction

The adverse effects of smoking in pregnancy have been well documented.[1] Apart from general health risks, expectant women who smoke are also at an increased risk of spontaneous miscarriage, preterm delivery and intrauterine growth retardation with resultant higher incidences of perinatal morbidity and mortality. Pregnancy presents a particularly important time to initiate smoking cessation intervention for women because of a mother's enhanced motivation to protect her foetus. Data has suggested that women who stopped smoking before 15 week's gestation had similar spontaneous preterm birth rates and small for gestational age infants as non-smokers, indicating that these severe adverse effects of smoking may be reversible if smoking is stopped early in pregnancy.[2] Furthermore, smoking cessation interventions have been shown to be effective in reducing continued smoking into late pregnancy, reducing the proportion of babies with low birth weight and preterm births as well as at increasing birth weight.[3] These findings have supported the need for smoking cessation programmes directed specifically at pregnant women.

In clinical practice, smoking cessation interventions are made available to pregnant women who verbalise their smoking status during the maternity booking visit. With

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increasing education about the hazards of smoking during pregnancy, patient denial of smoking may represent a socially desired response rather than true non-smoker status and these susceptible individuals will not be referred to smoking cessation services and receive the appropriate support to stop during pregnancy. Previous research has demonstrated varying degrees of concordance between self-reporting and various biochemical markers of nicotine intake, with studies suggesting up to a quarter of pregnant smokers are missed with purely self-reporting.[4-9]

While the prevalence of daily smoking in local female Singapore residents aged 18 to 65 years was low at 3.4%, the smoking rate was highest among young adults aged 18 to 29 years, and had increased in females aged 18 to 29 years from 6.6% in 2004 to 9.1% in 2007.[10] This is a particularly worrying trend as that female population also coincides with the reproductively active age group. Lower socioeconomic status and educational levels are significantly associated with smoking and nicotine dependence.[11] Distinct ethnic differences in nicotine dependence have also been previously studied, revealing that Malays had a higher prevalence compared to Indians and Chinese.[12]

There has been no study in multiracial Singapore which has assessed the antenatal prevalence of smoking and the robustness of self-reporting to identify pregnant smokers, hence this study was performed to fill this crucial gap in knowledge that would help shape future healthcare strategies.

Materials and Methods

A cross-sectional epidemiological survey of randomly sampled patients attending antenatal clinics at KK Women's and Children's Hospital was performed between July and August 2010. As the largest maternity facility in Singapore, the hospital provides care for over 12,000 women and their babies every year. This amounts to about one-third of the total number of babies born in Singapore. The patients have a wide ranging array of sociodemographic profiles that is reflective of the Singaporean population. This study was approved by the hospital's independent ethics committee (Centralised Institutional Review Board). Women were asked for their smoking status when they stepped into the clinic and were recorded as current active, former, passive (non-smoker with a spouse who smokes or living in an environment with frequent exposure to smoke) or non-smokers. After handing in their sample of urine for a dipstick test for albumin and glucose (done routinely at each clinic visit), a participant information sheet outlining the details of the study was given to each pregnant woman and the women had the option to opt out of the study if they desired. As the patient had reported smoking status prior to handing in their urine sample and reading the participant information sheet, they would not be able to change their self-declared smoking status.

Participants filled up a survey form of sociodemographic data including race, age, marital status, highest level of education, job and religion, as well as a short questionnaire on their awareness of the adverse effects of smoking. The questionnaire comprised of 10 questions with 5 relating to the general adverse effects of smoking on health, 3 questions on the effects of smoking on pregnancy and 2 questions on the effects of passive smoking (Appendix 1).

All women who opted to be included in the study had their urine sample results and forms tagged with a code number to allow analysis of the data to be carried out anonymously. As cotinine is derived only from nicotine metabolism, its measurement in urine is a good indicator of recent nicotine exposure. Cotinine testing was carried out using commercially available kits (Accutest® NicAlert™) and those performing the test were blind to the women's reported smoking status. The urine cotinine dipsticks were able to quantify the amount of exposure in the last 72 hours into 4 categories: non-smoker (level 0 corresponding to 0 to 10 ng/mL of cotinine equivalents), passive smoker (level 1-2 corresponding to 10 to 100 ng/mL of cotinine equivalents), light smoker (level 3-4 corresponding to 100 to 500 ng/mL of cotinine equivalents) and heavy smoker (level 5-6 corresponding to more than 500 ng/mL of cotinine equivalents). The sensitivity and specificity at a 100 ng/mL level were described by the NicAlert™ producer as 87% and 100% respectively. Self-declared active smokers were referred to a smoking cessation counsellor for intensive counselling involving an initial one-on-one therapy session outlining a plan for cessation and subsequent follow-up consults and phone sessions.

The prevalence of cotinine validated current smoking and self-reported current smoking were determined and compared (one-sample test of equality of proportions) using SPSS. Statistical significance of differences between categorical variables was determined using Pearson's x^2 test. T-tests and ANOVA (analysis of variance) were used to compare continuous patient characteristics by smoking status and cotinine concentration including comparison of questionnaire results. Stepwise logistic regression analyses were used to assess associations between subject characteristics with reported smoking status, urinary cotinine concentrations and questionnaire results. Characteristics included in the analysis were age, ethnicity, religion, marital status, highest level of education achieved and vocation.

Results

In total, 972 participants took part in the 1-month study period. None of the pregnant women approached to

participate in the study declined. Excluding 2 participants with missing urine cotinine data, the prevalence of active smokers was 5.2% (n = 50), with 3% (n = 29) being light smokers and 2.2% (n = 21) being heavy smokers (Table 1). This is in comparison to the self-reported active smoking status of 3.7% (n = 36). Proportion of self-reported status was significantly lower than cotinine validated smoking status (*P* = 0.02).

One of the 36 self-reported smokers had a negative urine cotinine test which might have reflected that the last smoking episode was more than 72 hours ago. There was also a significantly larger population of patients whose levels of urine cotinine were equivalent to passive smokers (n = 566) than self-declared passive smokers (n = 217); 101 (72.1%) out of 140 self-reported ex or former smokers had levels of urine cotinine equivalent to that of a passive smoker while 5 (3.6%) were classified as light smokers and 6 (4.3%) were heavy smokers according to the urine cotinine test (Table 2).

Analysis of the demographics of the study population (Table 3) revealed that the Malay race had the highest proportion of passive smokers (70%), light smokers (4.9 %) and heavy smokers (4.3%) according to the urine cotinine tests. This trend was similarly reflected for the Muslims in this study. While most of the active smokers fell into the 20 to 29 age group (n = 24) followed by the 30 to 39 age group (n = 15), those aged less than 20 years old had the highest proportion (22.7%) of smokers. A higher proportion of singles were smokers (11.7%) compared to the married women (4.8%); 33 (8.8%) out of 375 of those with education of up to secondary school were active smokers as compared to 3 (1.1%) of the 267 who had attended university. When categorised according to employment status, the unemployed had the highest proportion of active smokers (9.4%), followed by the housewives (6.3%) and then the students (5%).

Stepwise logistic regression showed that Malays were more likely to be active smokers than Chinese (odds ratio [OR]: 3.45; CI , 1.56 to 7.64; *P* value 0.002); smokers were more likely to be less than 20 years old (OR: 5.88; CI, 2.44 to 14.1; *P* value 0.00) and having a highest education level of junior college (high school equivalent) or a vocational college like polytechnic or Institute of Technical Education (ITE) compared to being a university graduate was associated with a higher likelihood of smoking (OR: 2.99; CI, 1.42 to 6.22; *P* value 0.003).

Knowledge of the adverse effects of smoking was generally good with a mean total score of 8.18 out of 10 (Table 4). Stratifying the patients by the urine cotinine levels, there was a difference in knowledge between the non-smokers, passive smokers, light smokers and active smokers (*P* = 0.012), with the non-smokers scoring the highest for awareness.

Table 1. Categorisation of Pregnant Women into Smoker Status Based on Urine Cotinine Results and Self-Reported Smoking Status in Pregnancy (n = 972)

Urine Cotinine Results	**Frequency n (%)**		**Self-Reported Smoking Status***	**Frequency n (%)**
Non-smoker	354 (36.4)		Non-smoker	579 (59.6)
Passive smoker	566 (58.2)		Passive smoker	217 (22.3)
Light smoker	29 (3.0)	50 (5.2)	Active smoker	36 (3.7)
Heavy smoker	21 (2.2)			
-	-		Ex-smoker	140 (14.4)
Missing data	2 (0.2)		-	-
Total	972 (100)		Total	972 (100)

*Inaccurate self-reporting rate: *P* value 0.02.

Discussion

The prevalence of active smoking pregnant patients in Singapore as validated with urine cotinine measurements was low at 5.2%. In comparison to other countries, where cotinine validated figures of current smokers reached 28% to 30%[8] and inaccurate self-reporting rates approached the highest rate of 38%,[13] the figures in the study were slightly

Table 2. Cross Tabulation of Declared Smoking Status with Classification by Urine Cotinine

Declared Smoking Status	**Urine Cotinine by 4 Categories***				
	Non-Smoker n (%)	**Passive Smoker n (%)**	**Light Smoker n (%)**	**Heavy Smoker n (%)**	**Total n (%)**
Non-smoker	266 (46.0)	302 (52.2)	6 (1.0)	4 (0.7)	578 (100)
Passive smoker	59 (27.3)	149 (69.0)	5 (2.3)	3 (1.4)	216 (100)
Ex-smoker	28 (20.0)	101(72.1)	5 (3.6)	6 (4.3)	140 (100)
Active smoker	1 (2.8)	14 (38.9)	13 (36.1)	8 (22.2)	36 (100)
Total	354 (36.5)	566 (58.3)	29 (3.0)	21 (2.2)	970 (100)

*Excluding 1 non-smoker and 1 passive smoker with missing cotinine data.

Table 3. Maternal Age, Ethnic Group, Religion, Marital Status, Highest Level of Education Reached and Employment Status in Relation to Smoking Status Using Urine Cotinine Levels*

Characteristics	Non-Smoker	Passive Smoker	Light Smoker	Heavy Smoker	Total
Age					
<20 (4.7)	8 (18.2)	26 (59.1)	6 (13.6)	4 (9.1)	44 (100)
20 – 29 (52.1)	165 (33.5)	303 (61.6)	15 (3.0)	9 (1.8)	492 (100)
30 – 39 (42.5)	168 (41.8)	219 (54.5)	7 (1.7)	8 (2.0)	402 (100)
>40 (0.7)	5 (71.4)	2 (28.6)	0 (0.0)	0 (0.0)	7 (100)
Missing data	8	16	1	0	25
Total (100)	346 (36.6)	550 (58.2)	28 (3.0)	21 (2.2)	945 (100)
Race					
Chinese (36.1)	155 (44.3)	184 (52.6)	7 (2.0)	4 (1.1)	350 (100)
Malay (35.8)	72 (20.7)	243 (70.0)	17 (4.9)	15 (4.3)	347 (100)
Indian (16.8)	72 (44.2)	86 (52.8)	4 (2.5)	1 (0.6)	163 (100)
Others (11.3)	55 (50.0)	53 (48.2)	1 (0.9)	1 (0.9)	110 (100)
Total (100)	354 (36.5)	566 (58.4)	29 (3.0)	21 (2.2)	970 (100)
Religion					
None (12.0)	50 (43.1)	62 (53.4)	3 (2.6)	1 (0.9)	116 (100)
Christian/Catholic (12.1)	61 (52.1)	54 (46.2)	1 (0.9)	1 (0.9)	117 (100)
Muslim (43.3)	94 (22.4)	289 (68.8)	21 (5.0)	16 (3.8)	420 (100)
Buddhist (21.5)	87 (41.6)	116 (55.5)	3 (1.4)	3 (1.4)	209 (100)
Hindu/Sikh (11.1)	62 (57.4)	45 (41.7)	1 (0.9)	0 (0.0)	108 (100)
Total (100)	354 (36.5)	566 (58.4)	29 (3.0)	21 (2.2)	970 (100)
Marital status					
Single (7.9)	13 (16.9)	55 (71.4)	9 (11.7)	0 (0.0)	77 (100)
Married (84.2)	316 (38.7)	461 (56.4)	20 (2.4)	20 (2.4)	817 (100)
Separated/divorced (7.8)	25 (32.9)	50 (65.8)	0 (0.0)	1 (1.3)	76 (100)
Total (100)	354 (36.5)	566 (58.4)	29 (3.0)	21 (2.2)	970 (100)
Highest level of education					
Secondary or less (38.7)	113 (30.1)	229 (61.1)	16 (4.3)	17 (4.5)	375 (100)
Junior college (9.2)	27 (30.3)	58 (65.1)	2 (2.2)	2 (2.2)	89 (100)
Polytechnic/ ITE (24.6)	73 (30.5)	156 (65.3)	8 (3.3)	2 (0.8)	239 (100)
University (27.6)	141 (52.8)	123 (46.1)	3 (1.1)	0 (0.0)	267 (100)
Total (100)	354 (36.5)	566 (58.4)	29 (3.0)	21 (2.2)	970 (100)
Occupation					
Employed (51.2)	184 (37.0)	296 (59.6)	10 (2.0)	7 (1.4)	497 (100)
Unemployed (13.2)	41 (32.0)	75 (58.6)	8 (6.3)	4 (3.1)	128 (100)
Student (2.1)	3 (15.0)	16 (80.0)	0 (0.0)	1 (5.0)	20 (100)
Retired (0.5)	4 (80.0)	1 (20.0)	0 (0.0)	0 (0.0)	5 (100)
Housewife (33.0)	122 (38.1)	178 (55.6)	11 (3.4)	9 (2.8)	320 (100)
Total (100)	354 (36.5)	566 (58.4)	29 (3.0)	21 (2.2)	970 (100)

ITE: Institute of Technical Education

*n = 970, with percentages in brackets.

more reassuring as the pregnant population had a much lower prevalence and only a 1.5% point difference between self-reported and cotinine validated smoking status. However, even with a low prevalence of smokers in the pregnant population, there appeared to be a significant discordance between self-reports of smoking status and urinary cotinine assays at antenatal visits (*P* value 0.02). From results of the study, self-reporting did not appear to be a valid and reliable indicator of smoking status in comparison to the urine nicotine test.

Table 4. Questionnaire Scores According to Urine Cotinine Classification*

Smoking Status	Mean Total Correct Scores Max = 10	Mean Score for General Effects Max = 5	Mean Score for Pregnancy Effects Max = 3	Mean Score for Effects of Passive Smoking Max = 2
Non-smoker (n = 354)	8.39 (2.28)	4.39 (1.16)	2.48 (0.83)	1.52 (0.74)
Passive smoker (n = 566)	8.14 (2.39)	4.38 (1.14)	2.37 (0.93)	1.39 (0.80)
Light smoker (n = 29)	7.28 (2.25)	4.00 (1.23)	2.14 (0.83)	1.14 (0.88)
Heavy smoker (n = 21)	7.19 (2.09)	3.95 (1.24)	2.19 (0.75)	1.05 (0.92)
Total (n = 970)	8.18 (2.35)	4.36 (1.15)	2.40 (0.89)	1.42 (0.79)

*Standard deviation in brackets.

Interestingly, one (2.8%) out of 36 self-reported active smokers had a negative urine cotinine test and 14 (38.9%) had a urine cotinine level that was indicative of passive smoking. This may indicate that the last smoking episode was more than 72 hours ago or could be a reflection of the higher clearance of nicotine and cotinine in pregnant women as suggested by previous research[14] where the half life of cotinine was 8.8 hours compared to 16.6 hours in the non-pregnant state. Thus, this biochemical method may also underestimate the true prevalence of pregnant smokers.

There was a significantly larger population of patients who tested positive for passive smoking levels of urine cotinine than self-declared passive smokers. This may be accounted for by a high proportion of former smokers who had declared themselves to be ex-smokers and not passive smokers but are still living in a home environment with spouses or relatives who smoke as 72.1% of ex-smokers had levels of cotinine in their urine equivalent to passive smokers. Second, this may also have reflected environmental exposure and the widespread prevalence of cigarette smoke in public areas that may have endangered maternal health without their knowledge. The Smoking (Prohibition In Certain Areas) Act was most recently updated on 15 January 2013 and involved an extension of the ban on smoking in indoor public areas, common residential areas and outdoor playgrounds, fitness corners and sports facilities. A long-term policy goal to prohibit smoking in all public areas except designated smoking points may help curb the adverse effects of passive smoke and it would be of interest to know if the proportion of passive smokers detected by urine continine after extension of the ban would be significantly decreased compared to the study results.

Despite strict implementation of policies and legislation in Singapore to reduce the prevalence of smoking, there has been an increasing rate of smokers among females. A previous study on smoking and nicotine dependence in Singapore[15] had indicated that the Malay ethnic community and the lower educated group of Singaporeans aged 18 to 34 years were more likely to smoke. Our findings are consistent with this study. However, while in that study, the odds of smoking were lower in the economically inactive groups of students and homemakers compared to those employed, this study found a higher proportion of smokers among housewives and the unemployed. Also, current smokers were more likely to be divorced or separated in that previous study while in this study, single pregnant patients formed the highest proportion of active smokers.

Knowledge of the adverse effects of smoking was high, reflecting good public health message dissemination. However, there were still differences in levels of knowledge between smokers and non-smokers. A confounding factor could be that smokers in general had a lower education level than non-smokers and hence might fare poorer in knowledge questionnaires. Furthermore, knowledge does not necessarily translate to behavioural modification and active smokers still require support from tailored smoking cessation programmes to provide significant health benefits to both mother and child.

This study substantiated the unreliability of self-reporting of smoking status in the pregnant population. It showed that a significant proportion of smokers could be missed and not referred to prenatal smoking cessation programmes. Further research is needed to elucidate how smoking patients can be ethically identified in a way that makes economical sense for maximal interventional efficacy. Suggestions to improve detection of smokers include extension of the single question assessment approach at first visit to a more comprehensive assessment at each trimester with an appropriately developed line of prompts aimed at encouraging the smokers to self-report. A biochemical validation of smoking status such as the urine cotinine dipstick or a carbon monoxide breath test could also be employed as part of the standard array of tests at first visit to screen all women. It had been suggested that a carbon monoxide breath test at maternity booking could increase the identification of pregnant smokers to 95%.[16] However, a cost-benefit analysis of such a strategy would have to be performed before the introduction of this measure. Apart from using biochemical means to screen

for smokers, point-of-care testing with urine cotinine and feedback in subsequent antenatal visits used in intervention programmes has been shown to significantly reduce smoking during pregnancy and increase birthweight[17] and could be incorporated in a smoking cessation programme.

Future studies are needed to evaluate the characteristics of smokers including multiparity and number of smokers in the household. Previous literature had shown that a woman who was multigravida was more likely to continue smoking during pregnancy and also if she had a partner who smoked.[18] It is probably necessary to expand smoking cessation strategies to address other smokers in the household to collectively encourage pregnant smokers to quit prenatally and continue to stay smoke-free even after delivery.

Conclusion

This study revealed the true prevalence of actively smoking pregnant patients seen in antenatal clinics by comparing self-reported smoking status of pregnant patients with their smoking status validated by means of a urine cotinine measurement. Although prevalence was low at 5.2%, there was a statistically significant rate of inaccurate self-reporting (current smokers who deny smoking status) highlighting the need to address pregnant smokers who had no access to smoking cessation programmes. The antenatal population is no different from the general female population in having lower socioeconomic status and educational level as significant risk factors for smoking. Pregnant women were generally well informed about the adverse effects of smoking and the effects of secondhand smoke on pregnancy; however there were still statistically significant differences in knowledge of non-smokers and smokers, hence these information gaps represent an avenue for further enhancement of smoking cessation strategies.

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REFERENCES

1. Giovino GA. The tobacco epidemic in the United States. Am J Prev Med 2007;33:S318-26.
2. McCowan LM, Dekker GA, Chan E, Stewart A, Chappell LC, Hunter M, et al. Spontaneous preterm birth and small for gestational age infants in women who stop smoking early in pregnancy: prospective cohort study. BMJ 2009;338:b1081.
3. Lumley J, Oliver SS, Chamberlain C, Oakley L. Interventions for promoting smoking cessation during pregnancy. Cochrane Database Syst Rev 2004;4:CD001055.
4. Russell T, Crawford M, Woodby L. Measurements for active cigarette smoke exposure in prevalence and cessation studies: why simply asking pregnant women isn't enough. Nicotine Tob Res 2004;6:S141-5.
5. Ford RP, Tappin DM, Schluter PJ, Wild CJ. Smoking during pregnancy: how reliable are maternal self reports in New Zealand? J Epidemiol Community Health 1997;51:246-51.
6. Klebanoff MA, Levine RJ, Morris CD, Hauth JC, Sibai BM, Ben Curet L, et al. Accuracy of self-reported cigarette smoking among pregnant women in the 1990s. Paediatr Perinat Epidemiol 2001;15:140-3.
7. Lindqvist R, Lendahls L, Tollbom O, Aberg H, Håkansson A. Smoking during pregnancy: comparison of self-reports and cotinine levels in 496 women. Acta Obstet Gynecol Scand 2002;81:240-4.
8. Patrick DL, Cheadle A, Thompson DC, Diehr P, Koepsell T, Kinne S. The validity of self-reported smoking: a review and meta-analysis. Am J Public Health 1994;84:1086-93.
9. Shipton D, Tappin DM, Vadiveloo T, Crossley JA, Aitken DA, Chalmers J. Reliability of self reported smoking status by pregnant women for estimating smoking prevalence: a retrospective, cross sectional study. BMJ 2009;339:b4347.
10. Ministry of Health, Singapore. National Health Surveillance Survey 2007. Available at: https://www.moh.gov.sg/content/dam/moh_web/Publications/Reports/2009/nhss2007.pdf. Accessed in 2015.
11. Siahpush M, McNeill A, Hammond D, Fong GT. Socioeconomic and country variations in knowledge of health risks or tobacco smoking and toxic constituents of smoke: results from the 2002 International Tobacco Control (ITC) four country survey. Tob Control 2006;15Suppl3:65-70.
12. Subramaniam M, Cheok C, Lee I-M, Pek E, Verma S, Wong J, et al. Nicotine dependence and psychiatric disorders among young males in Singapore. Nicotine Tob Res 2009;11:1107-13.
13. Albrecht SA, Reynolds MD, Salamie D, Payne L. A comparison of saliva cotinine, carbon monoxide levels, and self report as indicators of smoking cessation in the pregnant adolescent. Journal of Addictions Nursing 1999;11:93-101.
14. Dempsey D, Jacob P, Benowitz NL. Accelerated metabolism of nicotine and cotinine in pregnant smokers. J Pharmocol Exp Ther 2002;301;594-8.
15. Picco L, Subramaniam M, Abdin E, Vaingankar JA, Chong SA. Smoking and nicotine dependence in Singapore: findings from a cross-sectional epidemiological study. Ann Acad Med Singapore 2012;41:325-34.
16. Usmani ZC, Craig P, Shipton D, Tappin D. Comparison of CO breath testing and women's self reporting of smoking behaviour for identifying smoking during pregnancy. Subst Abuse Treat Prev Policy 2008;3:4.
17. Cope GF, Nayyar P, Holder R. Feedback from a point-of-care test for nicotine intake to reduce smoking during pregnancy. Ann Clin Biochem 2003;40:674-9.
18. Britton GR, Brinthaupt J, Stehle JM, James GD. Comparison of self reported smoking and urinary cotinine levels in a rural pregnant population. J Obstet Gynecol Neonatal Nurs 2004;33:306-11.

Appendix 1
Questionnaire

Circle the Number That Corresponds to Your Answer	1-True	2-False	3-Unsure
1) Smoking leads to a 2 to 4 times increased risk of heart disease.	1	2	3
2) Chronic smokers are likely to suffer from permanent lung damage resulting in lung and heart failure, and cancer.	1	2	3
3) Smoking causes a higher risk of stroke by more than 4 times.	1	2	3
4) Smokers have an increased risk of kidney, stomach, cervical, mouth, throat and tongue cancer.	1	2	3
5) Smoking can cause bad breath, discoloured teeth and premature wrinkling and ageing.	1	2	3
6) Smoking affects fertility for both males and females.	1	2	3
7) Cigarette smoking during pregnancy increases the risk of miscarriage, prematurity and low birth weight in the foetus.	1	2	3
8) Nicotine from cigarette smoke crosses the placenta and can also pass into the breast milk affecting the baby.	1	2	3
9) Smoker's children are more likely to get bronchitis, pneumonia, and other chest infections, especially in the first year of life.	1	2	3
10) Non-smokers living with smokers have a 35% increased risk of getting lung cancer.	1	2	3

Original Article

A Retrospective Review of Imaging and Operative Modalities Performed in Patients with Primary Hyperparathyroidism at a Mid-Volume Surgical Centre in Southeast Asia

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Abstract

Introduction: A paradigm shift appears to have occurred worldwide in surgery for primary hyperparathyroidism with the advent of sensitive preoperative imaging techniques. Preoperative imaging for parathyroid adenoma localisation was not found to be useful in a study conducted in Singapore in the 1990s. This study aimed to explore what the change has been in preoperative localisation tools compared to the previous study and if the ability of these tools to correctly localise pathologic parathyroid glands has improved. Materials and Methods: A retrospective review of patients who had surgery for primary hyperparathyroidism at our institution during the period 2005 to 2014 was carried out. Individuals with positive, as opposed to those with negative preoperative imaging, were compared with regard to whether they underwent limited focal or bilateral neck exploration. Length of hospital stay (LOHS) was also compared between patients who underwent limited versus bilateral exploration. Results: Fifty-eight patients who had preoperative imaging and surgery were evaluated. True positive rates of sestamibi, ultrasound and 4-dimensional (4D) computed tomography (CT) scans were 63.8%, 72.4% and 90%, respectively. Eighty percent of patients who had positive localisation had limited exploration. LOHS was 2.8 days (1.6, 4.8) and 4.3 days (2.1, 9.0) for limited and bilateral exploration respectively, *P* = 0.011. Conclusion: Our study highlights the marked change in the surgical landscape for primary hyperparathyroidism in the last 2 decades in Singapore. Improved preoperative localisation has resulted in a swing from predominantly bilateral, to limited exploration in almost all cases of primary hyperparathyroidism due to solitary adenoma. LOHS was significantly shorter in patients who had limited as compared to those who had bilateral exploration.

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Key words: 4D-CT, Localisation, MIBI, Parathyroid, Sestamibi, Ultrasound

Introduction

Primary hyperparathyroidism is a common cause of hypercalcaemia, particularly in the ambulatory setting with an estimated prevalence of 1 to 4 cases per 1000 persons.[1-3]

The clinical and laboratory diagnosis of primary hyperparathyroidism is well established in the presence of elevated serum calcium paired with increased serum parathyroid hormone (PTH) and the current definitive treatment of choice for the condition is surgery. Most surgical data suggest a cure rate of 95% to 98% in experienced hands with low complication rates.[4-6] The landscape of surgery for primary hyperparathyroidism has changed significantly in the last 2 decades with the advent of sensitive imaging techniques. The operative strategies have become increasingly disparate and the technical terms describing parathyroid operations also differ. Though an assortment of diverse parathyroidectomy procedures are often described as "minimally invasive", the precise surgical technique that qualifies for the term is controversial.[7] In general, limited exploration (LE) surgeries may include focal exploration which involves examination and excision of 1 parathyroid gland only or a unilateral exploration that examines the 2

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parathyroid glands located on one side of the neck. Bilateral exploration (BE) examines all 4 parathyroid glands.[8] Though the outcome of a preoperative localisation procedure generally does not influence the decision to operate but simply directs whether to perform a BE or a LE, an ongoing debate has centred on the optimal preoperative localisation method to be employed to identify the adenomatous gland(s).

Preoperative imaging to localise parathyroid glands before intended surgery was not found to be useful in a study conducted 15 years ago at our institution, a large tertiary teaching hospital.[9] The study had included patients with primary as well as tertiary hyperparathyroidism. Preoperative localisation in patients with primary hyperparathyroidism in that study conducted during 1990 to 1996, was correct only in 2 of 11 patients by ultrasound (US) scan, 6 of 15 patients by Technetium (99mTc) sestamibi (MIBI) scintigraphy and 12 of 29 patients by computed tomography (CT). These less than satisfactory rates were reflected in the then prevailing practice of bilateral neck exploration surgery in all patients.

Advances in imaging modalities along with changes in institutional practices with respect to diagnostic workup for primary hyperparathyroidism in the last 2 decades and a shift towards minimally invasive surgery have resulted in a greater reliance on preoperative imaging and localisation.[10] The ability of preoperative localisation methods to correctly identify pathologic parathyroid glands has been very variable depending on the patient population studied (single adenoma versus multiple gland disease), technique employed (MIBI vs US or CT) and experience of the operator and centre, with sensitivities ranging from 34% to 100% in published studies.[11] Sensitivity of US has been shown to range from 48.3% to 96.2%, and for MIBI scintigraphy from 61.4% to 94%.[12] Four-dimensional (4D)-CT is a relatively new multiphase imaging modality in which the first 3 "dimensions" are multiplanar CT axial acquisitions with coronal and sagittal reformations. The fourth "dimension" of 4D-CT is change in enhancement over time in non-contrast enhanced, arterial, and delayed (venous) phase imaging. 4D-CT has been reported to be more sensitive than sonography and scintigraphy for preoperative localisation of parathyroid adenomas.[13]

Tertiary hyperparathyroidism has the same biochemical characteristics as primary hyperparathyroidism. However, unlike primary hyperparathyroidism which is mostly due to a single adenoma and which would benefit from limited explorative or minimally invasive surgery, tertiary hyperparathyroidism usually has a preceding long standing secondary hyperparathyroidism phase, most often occurring in the setting of end-stage renal failure and is almost always due to multiple gland hyperplasia. Open surgery is thus required for all patients with tertiary hyperparathyroidism and thus, the value of preoperative imaging in it is limited.

The primary aim of our study was to understand whether there has been a change in preoperative localisation tools used for primary hyperparathyroidism in Singapore compared to 2 decades ago and to assess the extent to which the ability of these imaging tools to correctly localise pathologic parathyroid glands has improved. Our secondary aim was to explore whether there was a difference in surgical approach employed when imaging was positive with either US scan, MIBI scintigraphy or 4D-CT as compared to when it was negative and to see whether there was a difference in the length of postoperative hospitalisation stay between the patients who underwent either of the 2 surgeries viz limited focal versus BE. We also evaluated the biochemical cure rate achieved with either of the 2 operative modalities.

Materials and Methods

The study was done with prior ethics approval from the Centralised Institutional Review Board of our institution (CIRB 2014/480/C) and in accordance with Good Clinical Practice and the World Medical Association's Declaration of Helsinki. The CIRB approval included a waiver of informed consent.

Patients who had parathyroidectomy during the period 2005 to 2014 were identified from the surgical archives of our institution. Only those patients with confirmed primary hyperparathyroidism (as diagnosed by preoperative serum calcium levels more than the upper range of normal at our laboratory with a concomitant elevated or inappropriately normal PTH level, and calculated fractional excretion of calcium in the urine of more than 1%) were included in the analysis. Patients with secondary and tertiary hyperparathyroidism were excluded for the reasons explained above. Since the general practice at our institution (as is elsewhere in Singapore) is to perform subtotal/total parathyroidectomy for patients with multiple endocrine neoplasia (MEN) irrespective of preoperative imaging findings, those with MEN as well as those who did not have preoperative localisation imaging were excluded. This resulted in 58 patients who could be analysed (Fig. 1).

Case records and operative notes were reviewed to obtain information about the imaging modality performed, duration between initial biochemical diagnosis and the surgery, and the type of parathyroid surgery performed (LE vs BE). A MIBI scan with US scan was denoted as primary imaging. 4D-CT was considered as secondary imaging. Imaging was considered positive when findings that were in line with established characteristics for parathyroid adenomas on US scan, MIBI scan or 4D-CT were clearly seen and reported.[14-16] Imaging was considered concordant when both MIBI scan and sonography showed evidence of parathyroid adenoma

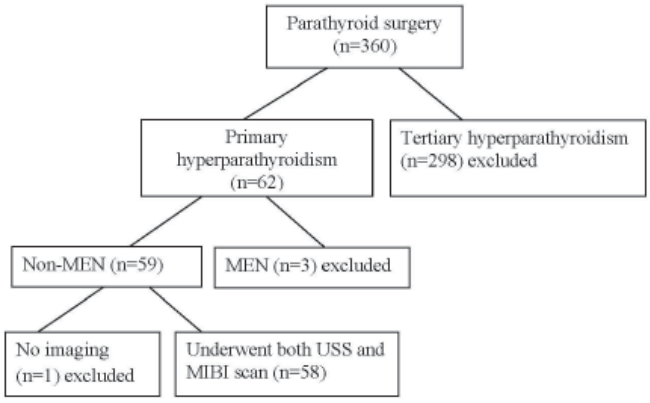

Fig. 1. Enumeration of patients.

and denoted as discordant when there was evidence of it by 1 modality and not by the other. The ability of preoperative localisation imaging in identifying pathological parathyroid gland(s) was evaluated by examining postoperative pathology reports with true positivity defined as congruent findings on imaging (identification of adenoma on US scan, MIBI scan or 4D-CT) and histopathology.

The impact of positive versus negative imaging was evaluated with regards to the type of surgery that was subsequently performed i.e. LE versus BE. Time interval from the identification of hypercalcaemia to surgery was compared between patients who had positive versus those who had negative primary imaging.

Biochemical cure rate was defined as normocalcaemia at 6-months postoperatively. Inpatient and outpatient notes were reviewed in order to calculate the length of hospital stay (LOHS) and the proportion of patients who achieved biochemical cure.

Statistical analysis was performed using IBM® SPSS® version 21. Parametric variables were expressed in mean ± standard deviation (SD). Non-parametric variables were expressed in median (25^{th} to 75^{th} percentile). The independent samples t-test was used in all the comparisons that were performed on parametric data and had *P* values generated. Skewness and kurtosis were explored using histograms. Skewness and/or kurtosis that is more than ± 1 suggests a non-normality in distribution. This non-normality was evident in the time interval from the identification of hypercalcaemia to surgery as well as the length of postoperative hospitalisation stay. Hence, log-transformation of these values was performed to convert them to a normal distribution before utilising parametric statistics viz independent samples t-test to ascertain the differences between groups.

Results

Descriptive statistics of the patient population and their biochemical parameters are provided in Table 1.

The standard practice at our institution in the last decade has been to perform concomitant MIBI scintigraphy and US scanning in all patients who are referred for parathyroid imaging for primary hyperparathyroidism. Patients in whom primary (initial) imaging (MIBI and US scans) failed to localise a pathologic parathyroid gland(s) or those in whom it is deemed necessary to clarify the findings of primary imaging are offered the imaging modality of 4D-CT. This practice of referring for 4D-CT however, appears to be a very recent development. Thus, of the 58 patients who were analysed, 12 had negative primary imaging and 9 amongst this group went on to have 4D-CT performed. All 9 of these patients had the parathyroid adenoma identified by 4D-CT. In 1 individual who had concordant positive US and MIBI scans, 4D-CT was done to clarify the findings of the primary imaging because both US and MIBI scans had suggested the presence of an intrathyroidal adenoma.

MIBI scan, US scan and 4D-CT had true positive rates of 63.8%, 72.4% and 90%, respectively (Table 2).

The ability of imaging techniques to identify pathological parathyroid gland(s) has improved compared to the previous study (Table 3). MIBI scintigraphy, and particularly US scan, had markedly improved performance.

Table 1. Baseline Characteristics of Patients (n = 58)

Baseline Characteristics	Values
Gender	
Female	60.3%
Male	39.7%
Ethnicity	
Chinese	84.5%
Malay	3.4%
Indian	5.2%
Other	6.9%
Mean age	58 ± 15 years
Mean calcium	2.84 ± 0.21 mmol/L
Median parathyroid hormone	19.6 pmol/l (11.4 to 28.2)
Mean 25-hydroxyvitamin D	22.3 ± 10.5 mcg/L
Clinical presentation/s	
Asymptomatic	41.4%
Gastrointestinal symptoms	24.1%
Renal stones	24.1%
Osteoporosis	19.0%
Musculoskeletal symptoms	20.7%

Table 2. Ability of Imaging Modalities to Correctly Localise Pathologic Parathyroid Glands

	MIBI Scintigraphy (n = 58)	US Scan (n = 58)	4D-CT (n = 10)
True positive localisation	63.8%	72.4%	90%
False positive localisation	3.4%	3.4%	10%
False negative localisation	32.8%	24.1%	0%

4D-CT: 4-dimensional computerised tomography; MIBI: Methoxyisobutylisonitrile; US: Ultrasound

Table 3. True Positive Rates of Imaging Modalities in Previous and Current Studies

	True Positive Rates in Previous Study*	True Positive Rates in Current Study
MIBI scintigraphy	40.0%	63.8%
US scan	18.2%	72.4%
CT	41.4%	Not applicable
4D-CT	Not applicable	90.0%

4D-CT: 4-dimensional computerised tomography; MIBI:Methoxyisobutylisonitrile; US: Ultrasound

*Koong HN, Choong LH, Soo KC. The role for preoperative localisation techniques in surgery for hyperparathyroidism. Ann Acad Med Singapore 1998;27:192-5.

An enumeration of the type of preoperative imaging modality and surgical approach employed is provided in Figure 2.

A total of 79.3% (n = 46) of patients had a positive MIBI and/or positive US scans; 94.8% of patients (n = 55) had a positive MIBI and/or positive US scans and/or positive 4D-CT of which 80% (n = 44) had LE. Of the 46 patients who had positive MIBI and/or positive US scans, concordant findings were obtained in 37 patients. Surgeons were even more likely to perform LE when the MIBI and US scans showed concordant results. Thirty-three (89.2%) of the 37 patients who had concordant MIBI and US scan findings in our series went on to have LE. Of the remaining 4 patients who actually had concordant results on US and MIBI scans and could have probably undergone LE, 1 had 4D-CT imaging that suggested bilateral involvement, 2 had concomitant thyroid nodules necessitating thyroidectomy, and in 1 patient, MIBI and US scans concordantly suggested bilateral involvement. Conversely, most patients with discordant imaging underwent BE. Of the total 9 patients who had discordant results on MIBI and US scans, 5 went on to have BE. Of the remaining 4, 3 had negative MIBI but positive US scan and underwent LE due to the surgeon's decision to trust the positive US scan finding as confirmatory of localisation. The fourth patient had an on-surgical table US scan that confirmed the earlier positive MIBI scan finding and therefore also underwent a LE.

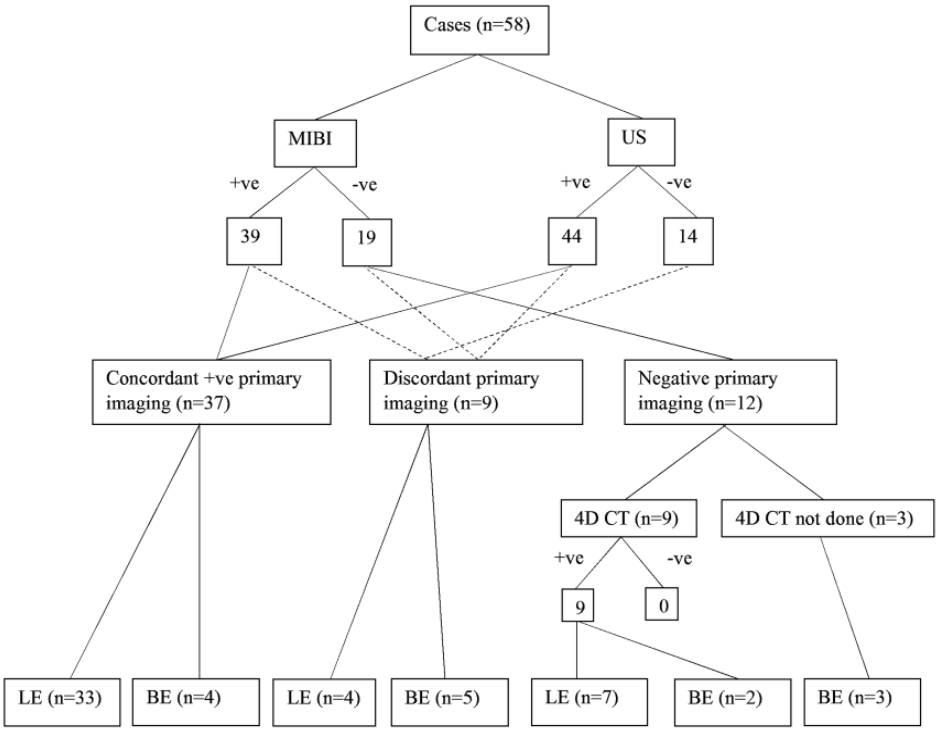

Fig. 2. Preoperative localisation imaging and type of surgery.

Table 4. Impact of Localisation Method on Type of Surgery

	Positive Localisation (n = 55)	Negative Localisation (n = 3)
Limited focal neck exploration	80%	0%
Bilateral neck exploration	20%	100%

Seven out of the 9 patients who had negative primary imaging and subsequently had a parathyroid adenoma identified by 4D-CT went on to have LE. Of the 2 who had BE, 1 patient had multinodular goitre and therefore underwent concomitant thyroidectomy through an open surgery and in the other case, the BE was a discretionary decision by the operating surgeon. The impact of localisation method on type of surgery is shown in Table 4.

The surgical methodologies employed were based on the principles of the anatomic basis of parathyroid surgery.[17] Frozen section confirmation of parathyroid tissue was performed for all specimens excised.

The mean time from detection of hypercalcaemia to surgery was 14.1 weeks (4.9 to 40.8) in those who had positive primary imaging as compared to those whose primary imaging was negative, in whom the mean time to surgery was 31.5 weeks (6.1 to 162.0); $P = 0.053$.

Biochemical cure rate was achieved in all but 1 of the 58 patients (98.3%). Of the 57 patients who were cured, 96.5% (n = 55) had single adenoma and 3.5% (n = 2) had multiple gland hyperplasia. Forty-three out of 44 patients who had LE achieved biochemical cure. In the 1 patient who did not achieve biochemical cure in the LE group, an apparent adenoma was identified and was surgically removed at the initial operation. Histology showed hyperplasia. However, despite repeat surgery with bilateral neck exploration in an attempt to remove all parathyroid tissue, this patient remained hypercalcaemic. So it can be assumed that the failure to attain biochemical cure in this patient was not likely due to the initial operative modality chosen but to a false localisation of potentially persistent pathology. All 14 of the patients who underwent BE achieved biochemical cure.

The mean calcium at 1-month postoperatively and at 6-months postoperatively were 2.30 mmol/L (SD: 0.14) and 2.30 mmol/L (SD: 0.11) respectively.

LOHS was 2.8 days (1.6, 4.8) and 4.3 days (2.1, 9.0) for limited and bilateral neck surgery respectively, $P = 0.011$. Fifty percent of limited neck exploration surgery patients versus 6% of bilateral neck surgery patients were able to be discharged within 2 days of surgery, $P = 0.001$.

Discussion

Our study demonstrates that even in a mid-volume[18] multiple-surgeon operative centre such as ours with a yearly total parathyroid surgical case volume of approximately 20 to 80, a major practice shift has occurred in the landscape of surgery for primary hyperparathyroidism. From a time when the oft-quoted dictum that the best localisation procedure for primary hyperparathyroidism was to localise a good surgeon, the ongoing improvement that has occurred in the sensitivity and specificity of MIBI and US scans, and the refinement of CT techniques have resulted in changes in even the type of surgery that is performed. The study from our centre in the 1990s had concluded that preoperative imaging to localise parathyroid glands was not useful.[9] This was the case noted in surgeries for both primary hyperparathyroidism as well as secondary and tertiary hyperparathyroidism. The extent of the procedure performed then was based on frozen section irrespective of the preoperative radiologic diagnosis. It has to be noted that sestamibi scanning had just been introduced at our hospital a mere 4 years prior to the publication of the above study.[19]

It was apparent from our retrospective review that compared to the previous study, the prevailing practice at our institution in the last decade has changed such that concomitant MIBI and US scan are performed as primary imaging for hyperparathyroidism. This also appears to be the favoured approach amongst surgeons in the United States as was revealed in a nationwide survey.[8] Concomitant use of MIBI and US scanning has been shown through several studies to give a combined sensitivity of more than 90% in detecting parathyroid adenomas.[20] All of the patients who had concordant MIBI and US imaging in our current study had the parathyroid adenoma correctly identified upon surgery.

A significant majority of patients had conventional planar CT scan as their primary imaging modality in the previous study.[9] This could have been a reflection of the fact that CT was more readily available than the other imaging modalities at that time. Localisation by CT was found to be correct only in 41.4% of patients in the above study.[9] This is not surprising since published studies during that era reported low detection rates of parathyroid adenomas with conventional CT imaging.[21] The authors of the study also did not find CT to be useful in differentiating between hyperplastic and adenomatous parathyroid glands. Unlike conventional CT that was not found to be useful in differentiating superior versus inferior parathyroid glands, the sensitivity of 4D-CT for the localisation of a single hyperfunctioning parathyroid gland to a quadrant in the neck is 73% to 97%.[22] Though 4D-CT may have value as a primary imaging modality,[23] it has to be noted that the thyroid-specific radiation dose associated with 4D-CT is 50 times that of MIBI scanning.[24,25] MIBI and US scanning hence probably should remain the primary imaging modality in the workup of primary hyperparathyroidism. It would be

appropriate for 4D-CT to be considered for patients with negative primary imaging. The use of 4D-CT was shown to result in an increased rate of successful localised focused parathyroid exploration in patients in whom localisation by MIBI or US scanning had failed.[26] 4D-CT is a relatively new modality that has become available in our institution. This novel modality correctly localised pathologic parathyroid glands in 90% of our cases. This preliminary finding of a very high true positive rate holds significant promise for the use of 4D-CT especially as a second-line imaging modality.

There has been a swing in practice from bilateral to limited unilateral/focal neck exploration surgery in those patients who have had a single adenoma identified on preoperative imaging. In our study, 80% of the patients who had positive imaging findings underwent LE. There are, however, potential issues that have to be addressed when considering LE. This type of surgery relies on successful localisation of the pathological gland preoperatively. Because of the increased risk for morbidity and failure in reoperation, the current consensus calls for 2 concordant imaging studies localising the hyperfunctioning parathyroid tissue before a LE is considered.[27] Discordant primary imaging should ideally be dealt with by BE though this is necessarily not always followed as was seen in our series. Parathyroidectomy success rates however, have been found to be similar in patients with MIBI scan-only or USS-only positive preoperative imaging compared to those with concordant ultrasound/MIBI imaging in a recent study.[15] Whether the success rate noted in this one study can be replicated by others needs to be seen. Patients with bilateral parathyroid hyperplasia as well as those who have negative preoperative imaging should also ideally be managed by BE.

The advantages of LE that have been demonstrated in a high-volume, single-surgeon setting are reduced operative duration, reduced LOHS, reduced overall cost and greater patient satisfaction.[28] Our study shows that these findings are true in a mid-volume, multiple-surgeon setting with those patients who underwent LE having significantly shorter postoperative hospitalisation stay compared to those who had BE.

Our study has some limitations. The findings are from a retrospective study of a series of patients presenting to a large tertiary teaching hospital and the operations were performed by multiple surgeons. This meant that though the surgical methods employed were uniform, there were some variations in decisions made as to whether LEs or BEs should be performed. Data collection for the study was made on the premise that all parathyroidectomy operations done at our institution would have been accurately recorded in the surgical archives. There was also a potential for error in transcription of laboratory data. However, this was mitigated by cross-referencing the manual case notes with electronic patient records. The sample size was relatively small; however, this is reflective of the primary hyperparathyroidism surgical case load not only at our institution but in most mid-volume surgical centres. Our study was not designed as a prospective controlled head-to-head comparison of the various imaging modalities and therefore, the true positive rates found should be interpreted appropriately. Since all patients in our series underwent some form of preoperative imaging, we could not explore the cost effectiveness of the preoperative imaging approach against non-image guided bilateral neck exploration. This has been evaluated previously in 2 studies both of which showed cost savings for preoperative imaging with minimally invasive surgery over bilateral neck exploration.[29-31]

Despite these limitations, our findings are consistent with those reported from larger studies conducted at high-volume surgical centres. The mid-volume multiple-surgeon setting is replicative of most centres that perform parathyroidectomies and we consider that the findings are likely to be replicated in other such centres that have dedicated nuclear medicine departments and trained ultrasonographers. The surgical technique that was predominantly used in our setting was that of a limited focal approach with a less than 2.5 cm incision under general anaesthesia. Whether this represents a true minimally invasive parathyroidectomy (MIP) is debatable. However, we have not attempted to denote our surgical approach as MIP and prefer to call it “limited image directed focal exploration”. Our biochemical cure rates with this approach for primary hyperparathyroidism in those patients who had positive primary imaging were comparable to that achieved by bilateral neck exploration.

Conclusion

Our study done at a mid-volume multiple-surgeon centre shows a marked change in the surgical landscape for primary hyperparathyroidism in the last 2 decades in Singapore. Improved imaging techniques have resulted in significantly enhanced preoperative localisation of the pathologic parathyroid gland and have also led to a dramatic swing from bilateral neck explorative predominance to limited focal exploration in almost all cases of primary hyperparathyroidism presenting with a solitary adenoma. Comparable cure rates were achieved with both operative modalities with hospitalisation stay being shorter for those patients who had LE as compared to those who had bilateral neck exploration.

REFERENCES

1. Griebeler ML, Kearns AE, Ryu E, Hathcock MA, Melton LJ 3rd, Wermers RA. Secular trends in the incidence of primary hyperparathyroidism over five decades (1965-2010). Bone 2015;73:1-7.
2. Marcocci C, Cetani F. Clinical practice. Primary hyperparathyroidism. N Engl J Med 2011;365:2389-97.
3. Yung CK, Fook-Chong S, Chandran M. The prevalence of recognized contributors to secondary osteoporosis in South East Asian men and post-menopausal women. Are Z score diagnostic thresholds useful predictors of their presence? Arch Osteoporos 2012;7:49-56.
4. Livingston CD. Radioguided parathyroidectomy is successful in 98.7% of selected patients. Endocr Pract 2014;20:305-9.
5. Rajaei MH, Oltmann SC, Adkisson CD, Elfenbein DM, Chen H, Carty SE, et al. Is intraoperative parathyroid hormone monitoring necessary with ipsilateral parathyroid gland visualization during anticipated unilateral exploration for primary hyperparathyroidism a two-institution analysis of more than 2,000 patients. Surgery 2014;156:760-6.
6. Wachtel H, Bartlett EK, Kelz RR, Cerullo I, Karakousis GC, Fraker DL. Primary hyperparathyroidism with negative imaging a significant clinical problem. Ann Surg 2014;260:474-80.
7. Henry JF. Minimally invasive thyroid and parathyroid surgery is not a question of length of the incision. Langenbecks Arch Surg 2008;393:621-6.
8. Greene AB, Butler RS, McIntyre S, Barbosa GF, Mitchell J, Berber E, et al. National trends in parathyroid surgery from 1998 to 2008: a decade of change. J Am Coll Surg 2009;209:332-43.
9. Koong HN, Choong LH, Soo KC. The role for preoperative localisation techniques in surgery for hyperparathyroidism. Ann Acad Med Singapore 1998;27:192-5.
10. Kunstman JW, Kirsch JD, Mahajan A, Udelsman R. Clinical review: parathyroid localization and implications for clinical management. J Clin Endocrinol Metab 2013;98:902-12.
11. Mihai R, Simon D, Hellman P. Imaging for primary hyperparathyroidism--an evidence-based analysis. Langenbecks Arch Surg 2009;394:765-84.
12. Cheung K, Wang TS, Farrokhyar F, Roman SA, Sosa JA. A meta-analysis of preoperative localization techniques for patients with primary hyperparathyroidism. Ann Surg Oncol 2012;19:577-83.
13. Rodgers SE, Hunter GJ, Hamberg LM, Schellingerhout D, Doherty DB, Ayers GD, et al. Improved preoperative planning for directed parathyroidectomy with 4-dimensional computed tomography. Surgery 2006;140:932-40.
14. Kamaya A, Quon A, Jeffrey RB. Sonography of the abnormal parathyroid gland. Ultrasound Q 2006;22:253-62.
15. Ebner Y, Garti-Gross Y, Margulis A, Levy Y, Nabrisky D, Ophir D, et al. Parathyroid surgery: correlation between pre-operative localization studies and surgical outcomes. Clin Endocrinol (Oxf) 2015;83:733-8.
16. Moralidis E. Radionuclide parathyroid imaging: a concise, updated review. Hell J Nucl Med 2013;16:125-33.
17. Wang C. The anatomic basis of parathyroid surgery. Ann Surg 1976;183:271-5.
18. Mitchell J, Milas M, Barbosa G, Sutton J, Berber E, Siperstein A. Avoidable reoperations for thyroid and parathyroid surgery: effect of hospital volume. Surgery 2008;144:899-906.
19. Ng DC, Ang ES, Goh AS, Sundram FX. Radionuclide imaging in primary hyperparathyroidism using 99mTc sestamibi–four case reports. Singapore Med J 1996;37:585-7.
20. Lumachi F, Ermani M, Basso S, Zucchetta P, Borsato N, Favia G. Localization of parathyroid tumours in the minimally invasive era: which technique should be chosen? Population-based analysis of 253 patients undergoing parathyroidectomy and factors affecting parathyroid gland detection. Endocr Relat Cancer 2001;8:63-9.
21. Tziakouri C, Eracleous E, Skannavis S, Pierides A, Symeonides P, Gourtsoyiannis N. Value of ultrasonography, CT and MR imaging in the diagnosis of primary hyperparathyroidism. Acta Radiol 1996;37:720-6.
22. Hunter GJ, Schellingerhout D, Vu TH, Perrier ND, Hamberg LM. Accuracy of four-dimensional CT for the localization of abnormal parathyroid glands in patients with primary hyperparathyroidism. Radiology 2012;264:789-95.
23. Eichhorn-Wharry LI, Carlin AM, Talpos GB. Mild hypercalcemia: an indication to select 4-dimensional computed tomography scan for preoperative localization of parathyroid adenomas. Am J Surg 2011;201:334-8.
24. Mahajan A, Starker LF, Ghita M, Udelsman R, Brink JA, Carling T. Parathyroid four-dimensional computed tomography: evaluation of radiation dose exposure during preoperative localization of parathyroid tumors in primary hyperparathyroidism. World J Surg 2012;36:1335-9.
25. Day KM, Elsayed M, Beland MD, Monchik JM. The utility of 4-dimensional computed tomography for preoperative localization of primary hyperparathyroidism in patients not localized by sestamibi or ultrasonography. Surgery 2015;157:534-9.
26. Udelsman R, Lin Z, Donovan PR. The superiority of minimally invasive parathyroidectomy based on 1650 consecutive patients with primary hyperparathyroidism. Ann Surg 2011;253:585-91.
27. Henry JF. Reoperation for primary hyperparathyroidism: tips and tricks. Langenbecks Arch Surg 2010;395:103-9.
28. Mahadevia PJ, Sosa JA, Levine MA, Zeiger MA, Powe NR. Clinical management of primary hyperparathyroidism and thresholds for surgical referral a national study examining concordance between practice patterns and consensus panel recommendations. Endocr Pract 2003;9:494-503.
29. Zanocco K, Heller M, Sturgeon C. Cost-effectiveness of parathyroidectomy for primary hyperparathyroidism. Endocr Pract 2011;17:69-74.
30. Ruda J, Stack BC Jr, Hollenbeak CS. The cost-effectiveness of sestamibi scanning compared to bilateral neck exploration for the treatment of primary hyperparathyroidism. Otolaryngol Clin North Am 2004;37:855-70.
31. Ruda JM, Stack BC Jr, Hollenbeak CS. The cost-effectiveness of additional preoperative ultrasonography or sestamibi-SPECT in patients with primary hyperparathyroidism and negative findings on sestamibi scans. Arch Otolaryngol Head Neck Surg 2006;132:46-53.

Commentary

The Impact of Education Reform: An Asian Medical School's Experience

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Abstract

This study assessed the effectiveness of education reforms on student-reported learning outcomes at the end of the 5-year medical school (M5) and 1-year internship (HO) in 2006, 2007 and 2008. A self-administered anonymous survey with 17 learning outcomes assessed, derived from Harden's Three-Circle Outcomes Model for outcomes-based education, was administered to 683 students at the end of medical school (M5) and internship (HO) from 2006, 2007 and 2008. We identified learning outcomes which changed significantly for internship (Cohorts A, B and C) and medical school (Cohorts B, C and D) between cohorts from 2006 to 2008, and compared learning outcomes between medical school and internship within cohorts (i.e. Cohort B which was M5 in 2006 and HO in 2007; Cohort C which was M5 in 2007 and HO in 2008). The proportion of students who agreed that medical school helped them achieve learning outcomes increased significantly from 2006 to 2008 for 15 out of 17 learning outcomes assessed. The proportion of students who agreed that internship helped them achieve learning outcomes increased significantly from 2006 to 2008 for 6 learning outcomes assessed. For Cohorts B and C, internship was more effective than medical school in achieving 8 learning outcomes. Cohort C reported that internship was more effective than medical school in 3 additional learning outcomes than Cohort B: patient management, humility and dedication. We conclude that a successful journey of education reform is an ongoing process that needs to comprehensively address multifaceted components such as faculty, administration and curriculum.

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Key words: Harden's Three-Circle Outcomes Model, Housemanship, Internship

Introduction

The Yong Loo Lin School of Medicine of the National University of Singapore (NUS Medicine) is the first medical school in Singapore and was established 111 years ago in 1905. The medical school has a 5-year undergraduate curriculum and 1-year housemanship, after which its students can then be fully registered.[1]

Education Reform (2002 to 2008)

In 2005, the Yong Loo Lin Trust made a transformational gift of S$100 million to NUS Medicine which was matched by the government. The gift provided funding to recruit and retain top faculty, develop state-of-the-art facilities and strengthen administrative infrastructure for both research and education.[2] Later in 2007, additional funding from the Ministry of Education was obtained to support clinical training; and the Centre for Biomedical Ethics (CBmE), South East Asia's first academic centre for biomedical ethics, was established through a donation from the Chen Su Lan Trust.[3] In January 2002, the Medical Education Unit (MEU) was created to support medical education in NUS Medicine

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through faculty development programmes, workshops and regional meetings like the Asia Pacific Medical Education Conference. The educational enhancements from 2002 to 2008 are detailed in Table 1 and online supplementary material at https://www.dropbox.com/s/1oy3hv9io7jhz7m/ONLINE%20SUPPLEMENTARY%20MATERIAL.docx?dl=0.

Assessment of Learning Outcomes

We assessed the effectiveness of these educational enhancements on medical students' learning outcomes by using student-reported learning outcomes at the end of medical school and housemanship using Harden's Three-Circle Outcomes Model which groups learning outcomes into 3 domains: 1) technical intelligence, 2) intellectual,

Table 1. Educational Enhancements at the Yong Loo Lin School of Medicine, 1999 to 2008

Educational Enhancement Curriculum	Year of Implementation
Medical school	
Harmonisation of training of medical students at partner training hospitals	
Standardised structure to medical student training	
Enhancement of professional development and communications programme	
Re-alignment of curricular goals to Accreditation Council for Graduate Medical Education (ACGME) physician competencies	
Introduction of standardised patients earlier in the first year	
Use of patient simulators spanning preclinical to clinical years	1999
Increase in ambulatory training in specialist outpatient and primary care clinics	
Embedding of medical students into healthcare teams in training hospitals	
Expansion of student housemanship programme in the final year	
Increased use of information technology and health information systems in hospitals for training of students	
Clinical Skills Foundation Course in the second year	
Structured Clinical Clerkship in the third year	
Housemanship	
Harmonisation of training of interns at partner training hospitals	
Standardised structure and assessment of intern training	
Re-alignment of intern training to Accreditation Council for Graduate Medical Education (ACGME) physician competencies	2005
Refinement of housemanship specialty postings	
Increased weighting on communication, interpersonal and teamwork skills in intern assessments	
Closer tracking of intern performance using more comprehensive logbooks and 360° feedback from teachers, peers and other healthcare team members	
Faculty (medical school and housemanship)	
Creation of more full time and fractional faculty positions which allowed retention and expansion of talent base	
Targeted appointment of clinical educators	
Protection of time for teaching	2005
Enhanced provision of resources to train teachers (e.g. medical education rounds, regular pedagogy workshops and conferences)	
Increased recognition of good teachers through award systems	
Establishment of Medical Education Unit (MEU) for faculty development, workshops and education research	
Establishment of the Centre for Biomedical Ethics	
Administration (medical school and housemanship)	
Creation of remunerated Associate Dean positions in satellite training hospitals to improve tracking, organisation and coordination of medical student and intern training	
Provision of funding for Associate Deans' offices	2005
Increased administrative support to monitor student feedback more closely and respond to it in a more timely manner	
Increased accountability of Associate Deans and partner institutions for quality of medical student and intern training	
Standardised reporting dashboard for medical education for comparison across clinical training sites	
Funding for medical education in training sites linked to dashboard indicators	

emotional, analytical and creative intelligences, and 3) personal intelligence.[4,5] We also determined the trends in learning outcomes from medical school between cohorts, trends in learning outcomes from housemanship between cohorts, and the differences in learning outcomes between medical school and housemanship within cohorts, from 2006 to 2008 as we hypothesised that education reforms implemented from 1999 to 2005 would effect changes in cohorts graduating between 2006 and 2008.

A self-administered anonymous survey was administered to all students at the end of medical school (M5) and housemanship (HO, during their end-of-housemanship graduation ceremony) in 2006, 2007 and 2008 which involved 4 cohorts (A, B, C and D). Students from Cohort A were HOs in 2006 (reference baseline group for HO), Cohort B were M5 in 2006 (reference baseline group for M5) and HOs in 2007, Cohort C were M5 in 2007 and HOs in 2008, and Cohort D were M5 in 2008.

The survey had 17 learning outcomes grouped into 3 categories (or "circles") in accordance with Harden's Three-Circle Outcomes Model[5] which were: 1) technical intelligence (the inner circle, i.e. "doing the right thing"), 2) intellectual, emotional, analytical and creative intelligence (the middle circle, i.e. "doing the thing right"), and 3) personal intelligence (the outer circle, i.e. "the right person doing it"). The inner circle of technical intelligence consisted of 6 learning outcomes: a) practical procedures; b) patient investigation; c) patient management; d) health promotion and disease prevention; e) communication; and f) appropriate information handling skills. Harden's original inner circle also contained a seventh learning outcome—basic clinical skills—but this was removed from our survey as we felt that there was overlap between what is perceived as basic clinical skills and the other domains within the inner circle. In the middle circle of intellectual, emotional, analytical and creative intelligences, we used Harden's original 3 learning outcomes which were: a) understanding social and clinical sciences underlying principles; b) attitudes, ethical and legal responsibilities; and c) decision-making skills, and clinical reasoning and judgement. We also added 3 new learning outcomes into the middle circle: d) integrity and honesty, as we felt that these were important but under-studied values needed a healthy doctor-patient relationship; e) compassion and empathy, as they were essential values which doctors need to possess, especially when informing patients of dreaded diagnoses; and f) approachability, because previous research on our students found that they identified these learning outcomes as uniquely important as they allow patients and colleagues to feel at ease when asking questions or seeking clarifications (Tan CH, Lim J, Koh DR. Intelligences in role model doctor: Harden three-circle model – a survey of final year medical students. Paper presented at: Association of Medical Education European Conference; September 6, 2004, Edinburgh, Scotland, UK; Lim J, Tan CH. What makes a good doctor? A survey of final year medical students. Paper presented at: Association of Medical Education European Conference; September 8, 2004, Edinburgh, Scotland, UK). In Harden's original outer circle of personal intelligence, there were only 2 learning outcomes: 'role of the doctor within the healthcare system' and 'personal development'. The first learning outcome of the outer circle was dichotomised into 2 major roles a doctor plays in the healthcare system: the a) role of the doctor as mentor/teacher and the b) role of the doctor as part of multi-professional team. The second learning outcome of the outer circle was expanded into 3 outcomes: c) self-improvement; d) humility, an important quality needed for self-regulation; and e) dedication, because previous research on our students found that they felt these learning outcomes were particularly important in our local Asian context (Tan CH, Lim J, Koh DR. Intelligences in role model doctor: Harden three-circle model – a survey of final year medical students. Paper presented at: Association of Medical Education European Conference; September 6, 2004, Edinburgh, Scotland, UK; Lim J, Tan CH. What makes a good doctor? A survey of final year medical students. Paper presented at: Association of Medical Education European Conference; September 8, 2004, Edinburgh, Scotland, UK). A 4-point Likert scale was used to assess the extent to which participants agreed that their medical school and housemanship experience were effective in helping them achieve each learning outcome: strongly disagree, disagree, agree or strongly agree. The data was collapsed into 2 categories before analysis: "disagree" consisting of strongly disagree and disagree, and "agree" consisting of agree and strongly agree. This study was approved by the National University of Singapore's Institutional Review Board.

We were unable to match the medical school survey results with the same cohort's housemanship survey results because the data was anonymously collected. The response rates for M5s and HOs were 76.4% and 80.4% in 2006, 61.2% and 52.4% in 2007 and 88.9% and 40.5% in 2008, respectively. Linear-by-linear association was used to test the trends and Chi-square analysis to compare between cohorts. We used Statistical Package for Social Sciences (Version 20) to perform statistical analyses and statistical significance was set at $P < 0.05$.

Learning Outcomes from Medical School between Cohorts

Fifteen of the 17 learning outcomes had significant increases in proportion of medical students who agreed that medical school helped to achieve them (Table 2). Within the inner circle of technical intelligences, 5 out of the 6 learning

Table 2. Perceptions from Three Cohorts of Final Year Students (M5) on Whether Medical School Helped Them Achieve Learning Outcomes According to Harden's Three-Circle Model

Learning Outcome	n (%)						Total (n = 515)		Rank by Total % Who Agree	*P* Value (Linear-by-Linear Association)
	M5 2006 (n = 175)		M5 2007 (n = 139)		M5 2008 (n = 201)					
	Disagree	Agree	Disagree	Agree	Disagree	Agree	Disagree	Agree		
1. Inner circle: technical intelligence										
(a) Practical procedures	43 (24.6%)	132 (75.4%)	20 (14.4%)	119 (85.6%)	25 (12.4%)	176 (87.6%)	88 (17.1%)	427 (82.9%)	7/8	0.020
(b) Patient investigation	27 (15.4%)	148 (84.6%)	14 (10.1%)\	125 (89.9%)	14 (7.0%)	187 (93.0%)	55 (10.7%)	460 (89.3%)	2	0.008
(c) Patient management	51 (29.1%)	124 (70.9%)	32 (23.0%)	107 (77.0%)	29 (14.4%)	172 (85.6%)	112 (21.7%)	403 (78.3%)	14	0.001
(d) Health promotion and disease prevention	43 (24.6%)	132 (75.4%)	26 (18.7%)	113 (81.3%)	28 (13.9%)	173 (86.1%)	97 (18.8%)	418 (81.2%)	12	0.009
(e) Communication	37 (21.1%)	138 (78.9%)	22 (15.8%)	117 (84.2%)	29 (14.4%)	172 (85.6%)	88 (17.1%)	427 (82.9%)	7/8	0.088
(f) Appropriate information handling skills	58 (33.3%)	116 (66.7%)	39 (28.1%)	100 (71.9%)	31 (15.4%)	170 (84.6%)	128 (24.9%)	386 (75.1%)	17	<0.001
2. Middle circle: intellectual, emotional, analytical and creative intelligences										
(a) Understanding of social and clinical sciences underlying principles	48 (27.4%)	127 (72.6%)	35 (25.2%)	104 (74.8%)	26 (12.9%)	175 (87.1%)	109 (21.2%)	406 (78.8%)	13	0.001
(b) Attitudes, ethical and legal responsibilities	57 (32.6%)	118 (67.4%)	35 (25.2%)	104 (74.8%)	32 (15.9%)	169 (84.1%)	124 (24.1%)	391 (75.9%)	16	<0.001
(c) Decision-making skills, clinical reasoning and judgement	39 (22.4%)	135 (77.6%)	29 (20.9%)	110 (79.1%)	23 (11.4%)	178 (88.6%)	91 (17.7%)	423 (82.3%)	9	0.005
(d) Integrity and honesty	39 (22.4%)	135 (77.6%)	24 (17.4%)	114 (82.6%)	15 (7.5%)	186 (92.5%)	78 (15.2%)	435 (84.8%)	5	<0.001
(e) Compassion and empathy	43 (24.6%)	132 (75.4%)	30 (21.9%)	107 (78.1%)	20 (10.0%)	181 (90.0%)	93 (18.1%)	420 (81.9%)	10	<0.001
(f) Approachability	47 (26.9%)	128 (73.1%)	42 (30.4%)	96 (69.6%)	30 (14.9%)	171 (85.1%)	119 (23.2%)	395 (76.8%)	15	0.005
3. Outer circle: personal intelligence										
(a) Role of the doctor as mentor/teacher	35 (20.0%)	140 (80.0%)	38 (27.3%)	101 (72.7%)	23 (11.4%)	178 (88.6%)	96 (18.6%)	419 (81.4%)	11	0.026
(b) Role of the doctor as part of multiple-professional team	22 (12.6%)	153 (87.4%)	17 (12.3%)	121 (87.7%)	8 (4.0%)	193 (96.0%)	47 (9.1%)	467 (90.9%)	1	0.003
(c) Self-improvement	23 (13.3%)	150 (86.7%)	18 (13.0%)	120 (87.0%)	15 (7.5%)	186 (92.5%)	56 (10.9%)	456 (89.1%)	3	0.067
(d) Humility	32 (18.3%)	143 (81.7%)	27 (19.6%)	111 (80.4%)	22 (10.9%)	179 (89.1%)	81 (15.8%)	433 (84.2%)	6	0.046
(e) Dedication	33 (18.9%)	142 (81.1%)	22 (15.9%)	116 (84.1%)	11 (5.5%)	190 (94.5%)	66 (12.8%)	448 (87.2%)	4	<0.001

Note: Numbers may not add up to total because of missing data. Only valid percentages are shown.

outcomes exhibited significant increases within the 3 years studied. Within the middle circle of intellectual, emotional, analytical and creative intelligences, all 6 learning outcomes exhibited significant increases within the 3 years studied. Within the outer circle of personal intelligences, 4 out of the 5 learning outcomes demonstrated significant increases within the 3 years studied.

Table 3. Perceptions from Three Cohorts of Post-internship Students (HO) on Whether Internship Helped Them Achieve Learning Outcomes According to Harden's Three-Circle Model

Learning Outcome	n (%)						Total (n = 456)		Rank by Total % Who Agree	*P* Value (Linear-by-Linear Association)
	HO 2006 (n = 168)		HO 2007 (n = 120)		HO 2008 (n = 92)					
	Disagree	Agree	Disagree	Agree	Disagree	Agree	Disagree	Agree		
I. Inner circle: technical intelligence										
(a) Practical procedures	47 (28.0%)	121 (72.0%)	23 (19.2%)	97 (80.8%)	11 (12.0%)	81 (88.0%)	81 (21.3%)	299 (78.7%)	16	0.002
(b) Patient investigation	25 (14.9%)	143 (85.1%)	10 (8.3%)	111 (91.7%)	4 (4.3%)	88 (95.7%)	39 (10.3%)	341 (89.7%)	4/5	0.005
(c) Patient management	33 (19.6)	135 (80.4%)	25 (20.8%)	95 (79.2%)	10 (10.9%)	82 (89.1%)	68 (17.9%)	312 (82.1%)	15	0.118
(d) Health promotion and disease prevention	51 (30.4%)	117 (69.6%)	18 (15.0%)	102 (85.0%)	15 (16.3%)	77 (83.7%)	84 (22.1%)	296 (77.9%)	17	0.003
(e) Communication	34 (20.4%)	133 (79.6%)	19 (15.8%)	101 (84.2%)	11 (12.0%)	81 (88.0%)	64 (16.9%)	315 (83.1%)	14	0.078
(f) Appropriate information handling skills	34 (20.4%)	133 (79.6%)	17 (14.2%)	103 (85.8%)	9 (9.8%)	83 (90.2%)	60 (15.8%)	319 (84.2%)	13	0.022
2. Middle circle: intellectual, emotional, analytical and creative intelligences										
(a) Understanding of social and clinical sciences underlying principles	27 (16.2%)	140 (83.8%)	11 (9.2%)	109 (90.8%)	6 (6.5%)	86 (93.5%)	44 (11.6%)	335 (88.4%)	8	0.014
(b) Attitudes, ethical and legal responsibilities	29 (17.3%)	139 (82.7%)	15 (12.5%)	105 (87.5%)	12 (13.0%)	80 (87.0%)	56 (14.7%)	324 (85.3%)	12	0.296
(c) Decision-making skills, clinical reasoning and judgement	30 (17.9%)	138 (82.1%)	12 (10.0%)	108 (90.0%)	8 (8.8 %)	83 (91.2 %)	50 (13.2%)	329 (86.8%)	10	0.025
(d) Integrity and honesty	21 (12.5%)	147 (87.5%)	11 (9.2%)	109 (90.8%)	7 (7.6%)	85 (92.4%)	39 (10.3%)	341 (89.7%)	4/5	0.192
(e) Compassion and empathy	20 (11.9%)	148 (88.1%)	13 (10.8%)	107 (89.2%)	10 (10.9%)	82 (89.1%)	43 (11.3%)	337 (88.7%)	6/7	0.778
(f) Approachability	19 (11.3%)	149 (88.7%)	17 (14.2%)	103 (85.8%)	10 (10.9%)	82 (89.1%)	46 (12.1%)	334 (87.9%)	9	0.969
3. Outer circle: personal intelligence										
(a) Role of the doctor as mentor/teacher	25 (15.1%)	141 (84.9%)	13 (10.8%)	107 (89.2%)	15 (16.3%)	77 (83.7%)	53 (14.0%)	325 (86.0%)	11	0.945
(b) Role of the doctor as part of multiple-professional team	19 (11.4%)	148 (88.6%)	10 (8.3%)	110 (91.7%)	9 (9.8%)	83 (90.2%)	38 (10.0%)	341 (90.0%)	3	0.598
(c) Self-improvement	11 (6.6%)	155 (93.4%)	9 (7.5%)	111 (92.5%)	6 (6.5%)	86 (93.5%)	26 (6.9%)	352 (93.1%)	1	0.982
(d) Humility	21 (12.8%)	143 (87.2%)	14 (11.7%)	106 (88.3%)	6 (6.5%)	86 (93.5%)	41 (10.9%)	335 (89.1%)	6/7	0.141
(e) Dedication	15 (9.0%)	152 (91.0%)	13 (10.9%)	106 (89.1%)	5 (5.4%)	87 (94.6%)	33 (8.7%)	345 (91.3%)	2	0.434

Note: Numbers may not add up to total because of missing data. Only valid percentages are shown.

Learning Outcomes from Housemanship between Cohorts

Six of the 17 learning outcomes had significant increases in proportion of interns who agreed that housemanship helped to achieve them (Table 3). Within the inner circle of technical intelligences, 4 out of the 6 learning outcomes exhibited significant increases within the 3 years studied. Within the middle circle of intellectual, emotional, analytical

and creative intelligences, only 2 out of the 6 learning outcomes exhibited significant increases within the 3 years studied. Unlike medical school, none of the 5 learning outcomes of the outer circle of personal intelligences from housemanship demonstrated any significant increase within the 3 years studied.

Learning Outcomes from Housemanship within Cohorts

Both Cohorts B and C reported that housemanship was more effective than medical school in achieving all 6 learning outcomes within the middle circle (Table 4). Both Cohorts B and C also reported that housemanship was more effective than medical school in learning appropriate information handling skills (inner circle) and the role of the doctor as a mentor or teacher (outer circle). However, the later cohort (Cohort C) additionally reported that housemanship was more effective than medical school in learning patient management (inner circle), and humility and dedication (both from outer circle).

Table 4. Comparison of Learning Outcomes between Medical School and Internship for Both Cohort B (M5 2006 vs HO 2007) and Cohort C (M5 2007 vs HO 2008)

Learning Outcome	*P* Value (Chi-square)	
	Cohort B (M5 2006 vs HO 2007)	Cohort C (M5 2007 vs HO 2008)
1. Inner circle: technical intelligence		
(a) Practical procedures	0.313	0.581
(b) Patient investigation	0.089	0.109
(c) Patient management	0.127	0.018
(d) Health promotion and disease prevention	0.056	0.723
(e) Communication	0.244	0.398
(f) Appropriate information handling skills	<0.001	0.001
2. Middle circle: intellectual, emotional, analytical and creative intelligences		
(a) Understanding of social and clinical sciences underlying principles	<0.001	<0.001
(b) Attitudes, ethical and legal responsibilities	<0.001	0.023
(c) Integrity and honesty	0.004	0.032
(d) Compassion and empathy	0.004	0.029
(e) Approachability	0.012	<0.001
(f) Decision-making skills, clinical reasoning and judgment	0.005	0.014
3. Outer circle: personal intelligence		
(a) Role of the doctor as mentor/teacher	0.045	0.048
(b) Role of the doctor as part of multiple-professional team	0.243	0.539
(c) Humility	0.150	0.005
(d) Self-improvement	0.149	0.109
(e) Dedication	0.082	0.015

Discussion

We found that the learning outcomes for both medical students and interns progressively improved between and within consecutive student cohorts from 2006 to 2008. We hypothesise that the establishment of the Centre for Biomedical Ethics in 2006 could have been responsible for the improvements in learning "attitudes, ethical and legal responsibilities" and "integrity and honesty" in our medical students. However, it is not possible to objectively attribute which each educational enhancement introduced into medical school and housemanship to each learning outcome as the intervention was a complex one. Instead, the education enhancements probably had varying influences on each other, akin to complexity science, and should be viewed as a whole education ecosystem with elements of dynamic interactions.[6] Nevertheless, the education reform process was most likely the underpinning driver of these improvements from 2006 to 2008.

For the 2 cohorts who were surveyed on both their medical school and housemanship experience (Cohorts B and C), the students felt that housemanship was better at achieving all the learning outcomes within the middle circle (intellectual, emotional, analytical and creative intelligences) than medical school. We hypothesise that regular supervision and role-modelling over a sustained period and exposure to real contexts and practical situations during housemanship resulted in the houseman being better at achieving the learning outcomes within the middle circle.

Education reform, improvement and refinement are a constant process but many medical schools struggle to find funds to implement these changes. NUS Medicine was in the fortunate position to have leadership willing to prime the education enterprise with the necessary startup resources and foundation for the change process, and to continually strive for quality improvement. The experience provided much needed impetus to justify a substantial increase in funding from the education ministry. This allowed the school to build on its early successes and establish a sustainable core of clinical educators and administrators for the school. Our findings support the work done by Verstegen and King, who reviewed and analysed 35 years of production functional research, and concurred that resource inputs into schooling

influences the academic educational outcomes of students.[7] Nevertheless, the aim of this case study was not to be self-laudatory but to share with the medical education community our experience on how properly targeted resource allocation dedicated to educational enhancements in our medical school led to tangibly better learning outcomes as reported by our students. We do not propose that a mere increase in funding will automatically translate to better learning experiences for medical students but emphasise instead that a successful journey of education reform is an ongoing process that needs to comprehensively address multifaceted components such as faculty, administration and curriculum.

Study Limitations

Our study also has limitations. Firstly, the response rates for post-internship surveys in 2007 and 2008 were less than ideal (52.4% and 40.5%, respectively). Secondly, the learning outcomes achieved were self-reported and not assessed with a standardised accrediting examination. We also did not survey HOs who graduated overseas or supervisors for their opinions on the competency of HOs. Lastly, our results were observed for only 3 years and it is uncertain if the improved learning outcomes were sustained after 2008.

Conclusion

Education reforms and sustained education quality improvement over time in a large Asian medical school led to improved learning outcomes from both medical school and housemanship. A successful journey of education reform is an ongoing process that needs to comprehensively address faculty, administration and curriculum.

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REFERENCES

1. Chew CH. Medical education, training and health care services in the Republic of Singapore. West J Med 1991;155:186-8.
2. Yong Loo Lin School of Medicine. Transformational gift. Available at: http://medicine.nus.edu.sg/corporate/aboutus/abtus-transformational_gift.aspx. Accessed on 16 January 2013.
3. Yong Loo Lin School of Medicine, National University of Singapore. Center for Biomedical Ethics. About us. Available at: http://cbme.nus.edu.sg/aboutus.html. Accessed on 16 January 2013.
4. Harden RM, Crosby JR, Davies MH. AMEE Guide No. 14: Outcome-based education: Part 1-An introduction to outcome-based education. Med Teach 1999;21:7.
5. Harden RM, Crosby JR, Davies MH, Friedman M. Amee Guide No. 14: Outcome-based education: Part 5-From competency to meta-competency: a model for the specification of learning outcomes. Med Teach 1999;21:546.
6. Plsek PE, Greenhalgh T. Complexity science: the challenge of complexity in health care. BMJ 2001;323:625-8.
7. Verstegen DA, King RA. The relationship between school spending and student achievement: a review and analysis of 35 years of production function research. J Educ Finance 1998;24:243-62.

Commentary

Enhancing Doctors' and Healthcare Professionals' Patient-care Role through Actor-training: Workshop Participants' Responses

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Introduction and Purpose

Workshops for "Applying Techniques from Actor-training to Performativity of Doctors and Healthcare Practitioners" were held in September 2013 and January 2014 within Yong Loo Lin School of Medicine (YLLSoM), National University of Singapore (NUS). The aim of the training was to provide healthcare professionals (HCPs) with both skills and an "embodied" understanding, as a basis for the expansion of their "performativity" and effectiveness in relating to patients. The rationale for these workshops was to offer HCPs training in acting on the grounds that:

- Acting is to express oneself effectively and authentically;
- Theatre work, including work with masks, is not to hide but to accentuate;
- There are many parallels between "theatre" and "medicine";
- An ability to relate well with patients goes beyond communication skills and role playing and requires "embodied practice"—which actors are skilled in; and
- Training as an actor offers a capacity to be simultaneously empathic and analytic.

These were the underlying positions from an actor-training perspective, on which the training was founded, and we have provided justifications for them in a previous paper along with an elaboration of terms such as "embodied" and "performativity".[1] In this paper, we report participants' responses to the workshops and the extent to which their responses supported our aims in conducting the training.

There is support for offering doctors and other HCPs actor-training in the literature. Finestone and Conter, for example, contend that "doctors must be actors—better actors than they are now".[2,3] Dakin proposes "training of doctors in acting skills rather than just with the use of acting skills" by which he means going beyond the commonplace use of role-play to "train doctors in clinical situations when they feel genuine internal emotions". He adds that "there may be even more to gain from our involvement with the acting profession".[4]

Participants

The training involved 45 HCPs. The majority were consultant or senior consultant clinicians (31). There were 22 participants in the first workshop (all of whom lived and worked in Singapore) including 13 clinicians (both proceduralist and non-proceduralist), 2 residents, and 7 nurses. In Workshop 2, there were 23 participants: 18 clinicians (both proceduralist and non-proceduralist); 2 nurses; 1 pharmacist; 1 public health worker, and 1 researcher. A distinguishing feature of Workshop 2 was that one-third of the participants were from countries beyond Singapore (5 Indonesians; 1 from China; 1 from Hong Kong, 1 Sri Lankan).

Materials and Methods

The first of 24-hour workshops was conducted for clinical and teaching staff associated with the NUS Medical School. The second workshop was one of many workshops held as part of an international conference: the 2014 Asia Pacific Medical Education Conference (APMEC). The NUS Institutional Review Board (IRB) approved the study in relation to the first workshop. Although the IRB did not review the study in relation to the second workshop, participants were asked for feedback on workshop activites in the same way, and all responses were anonymised and collected by the conference secretariat as part of APMEC feedback, prior to analysis for this paper.

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Experiential theatre training exercises were conducted by an experienced actor-director and acting teacher (Author 2: who co-facilitated with Authors 1 and 3) in 2 separate 4-hour workshops with 2 different groups of participants. Participants gave feedback in questionnaires and 6 of the participants from Workshop 1 were interviewed following that workshop. The major experiential activities (requiring active participation) in both workshops were body awareness activities and work with a white expressionless mask.

Each of the workshops began with an ice-breaking exercise followed by an exercise in mask. Three participants acted, in succession, the role of "patient" suffering from a particular disease syndrome (Parkinson's disease, depression, and eczema), and partnered with another participant, as "doctor", who was asked to diagnose the "patient". Each pair performed in white masks and acted their roles in silence. Following this, the workshop facilitators performed a similar role-play, although without masks, in which one of the facilitators, as "patient", acted a number of roles in silence: "demanding", "pleading", "passive-help me", and the other facilitator, as "doctor", responded (also silently) to each of these roles. Participants discussed what they had observed about their fellow participants performing in mask, and the facilitators performing without mask. Then, participants were led through an activity developed by Michael Chekhov—the Russian-American actor, director, and theatre practitioner.[5] This comprised standing upright and moving from a centre position left, right, front, and back; raising up on toes to experience height and imagining being heavy and pulled down by gravity through the feet while maintaining a sense of body centeredness (described in Table 1 as "Leaning Exercise"). The aim of this exercise is to support the actor/participant in experiencing the impact of moving in space on one's sense of embodiment.

In a further exercise, participants in mask mingled while observing one another. They then removed their mask, and were prompted to hold and regard the mask "as an object of respect" (following an approach taught by renowned drama teacher Jacques Lecoq).[6] With this attitude, they again mingled, in mask, and observed one another for a second time. The differences between performing with these two attitudes toward the mask ("just an object" vs "an object of respect") were discussed by participants who (in both workshops) related these attitudes to the mask—blasé and respectful—to the various attitudes one may have towards one's role as a HCP. Next, participants were led through an exercise also inspired by Chekhov,[5] comprising gestures with sound and movement. Each set of movements was an action such as moulding, floating, flying and radiating and each of these was associated with a corresponding element and sound (respectively: earth and the sound "D"; water with "L"; air with "R"; and fire with "F"). Following this, participants improvised and performed their "assigned" element—whilst wearing a white mask. Subsequently individual "elemental groups" interacted spontaneously in a meeting of all 4 elements with their appropriate movements and sounds.

Fig. 1. Workshop participants in mask as "patient" (left) and "doctor" (right).

Results

Responses to Questionnaire Survey

Following both workshops, participants were asked to rate the various activities within their workshop "on their usefulness to you". There were some differences between the survey instruments for each workshop principally because

Table 1. Workshop Participants' Ratings of the "Usefulness" of Activities (which were Common to Both Workshops)

Activities Common to Both Workshops	September 2013 (%): "Good" or "Very Good"*	January 2014 (%): "Good" or "Excellent"†
Leaning exercise: "Six Directions of Space"	100.0‡	72.2‖
"Doctor" responding to "patient" (in mask)	100.0§	77.7‖
Movement activity; Intro to the mask; and 4 elements	100.0§	72.2‖
Presentation in mask: 4 elements	90.5§	70.7‖
Reflections at the end of workshop	95.2§	82.3‖

Number of participants in September 2013 Workshop 1 = 22
Number of participants in January 2014 Workshop 2 = 23
*September 2013 workshop response options were: "Poor", "Acceptable", "Good", "Very Good".
†January 2014 workshop response options were: "Excellent", "Good", "Average", "Below Average", "Poor".
‡20 of 22 participants responded.
§21 of 22 participants responded.
‖19 of 23 participants responded.

the feedback sheet for Workshop 2 was the standard form for all APMEC workshops. The main difference was that the scale for responses for Workshop 1 was a 4-point Likert scale, whereas Workshop 2 employed a 5-point Likert scale. There were also differences between terms of those 2 scales and particularly between the terms "Good" or "Very Good" for Workshop 1 as opposed to "Good" or "Excellent" for Workshop 2 (as shown in Table 1). Table 1 shows the percentage of participants who rated activities common to both workshops as "Good" or "Very Good"/"Excellent".

Qualitative Responses

Participants were asked what they had "gained from this workshop"; and how they would "implement/adapt/apply" what they had learned in their professional practice. Answers to these 2 questions tended to overlap, and are combined and presented under the following headings which were identified from a thematic analysis of the comments.[7] These were:

- Care for patients
- Body language, communication and emotion
- Acting skills
- Self-awareness, mindfulness
- Teaching.

The issue of "authenticity-inauthenticity" arose in discussion with participants at the end of Workshop 1, but not in Workshop 2. The issue was discussed in Workshop 1 in relation to whether acting itself is "putting-on-an-act"—as it is conventionally represented—or whether acting is, or can be, a "genuine" expression. The other form of this question as it arose was whether, in wearing a mask, the actor was "hiding behind the mask" or whether the mask accentuated, in some form, what was real and genuine. Following Workshop 1, comments on this issue were offered in the questionnaire in response to both open-ended questions, and these are presented in Table 3.

Workshop 2 (but not Workshop 1) participants were asked to rate the workshop on "enjoyment" and 17 of the 18 respondents rated it "Good" or "Excellent". Workshop 2 (but not Workshop 1) participants were also asked for "Other comments about the workshop" and of the 6 comments received, 4 were assessments of the workshop itself ("Interesting and eye-opening"; "Very well-prepared, workshop team"; "The purpose should be clearer" and "Make relevance to clinical environment more explicit"). Another 2 addressed the learning process: "Difficult learning! This is experiential"; and "It was something different from the other [APMEC] workshop. It was a lot of fun to have to act and perform. But it is very difficult to relate this to work."

Table 2. Selected* Responses† to Open-ended Questions Following Both Workshops Grouped Within Common Themes

Question 1: What have You Gained from this Workshop? **Question 2: How would You Implement/Adapt/Apply Your Learning in Your Professional Practice?**
Care for patients (3 of 5 responses)
Performance as a means to explain and enhance doctor-patient relationship.
Realised effect of [one's own] state on quality of patient-doctor interaction. Clues to identifying [one's] "state". How to "move" [one's] state. Clearer understanding of performativity.
To be aware to observe the patient. Relationship between doctor and patient (related to patient-empathy).
Body language, communication and emotion (3 of 9 responses)
Mask exercise, which made me more aware of our body/gestures speak a lot too. And I need to be mindful about this myself.
The role-playing...[with the] mask is a good tool to use for communication workshop—to emphasise the need for body language.
An emotional understanding.
Acting skills (3 of 4 responses)
Understanding about the mask and role. Opened my eyes to the realm of acting. Aware of the non-physical aspects of self.
More respect and appreciation for acting as an art. A...deeper reflection on issues of what it means to perform a role.
Everyone has multiple roles to play in real life. We should respond to different situation with controlled and appropriate elements so that the patient or other people will benefit.
Self-awareness, mindfulness (3 of 12 responses)
Enlightenment/Awareness/Be more observant/Be more mindful of my behaviour/Create comfort, remove discomfort/Personal development/Be more self-aware, control of oneself.
Heightened realisation of various aspects of my behaviour—how I might control it.
Insight into how we as professionals can become conscious of our activities and their impact on our lives.
Teaching (2 of 9 responses)
Ideas for teaching communication and self-awareness.
I would have to be more mindful when teaching students...More importantly, I have to impart to students too that they do need to be mindful of their actions.

*Three of the 4 authors selected the responses that communicate simply and offer a clear perspective and eliminated those which communicate less simply, or where the idea had already been conveyed by another comment.
†30 (20 from Workshop 1 and 10 from Workshop 2) of 31 questionnaire respondents who offered qualitative comments.

Interviews

Workshop 1 participants were asked if they would be available for interview in the 4 weeks following the workshop and 6 volunteered. All 6 of them were clinicians in one of the following specialties: anaesthesia, emergency medicine, psychological medicine, orthopaedic surgery, otorhinolaryngology and family medicine. Three of the

Table 3. Responses from Questionnaires Relating to Authenticity—Inauthenticity—Wearing a Mask*

Question 1: What have You Gained from this Workshop? **Question 2: How would You Implement/Adapt/Apply Your Learning in Your Professional Practice?**
Authenticity/inauthenticity
Answer to my question raised this morning about the authenticity of utilising "performativity" skills in our clinical setting.
Authenticity and discovery of self-awareness.
You cannot "act" genuine. You take on the role fully when you put on the mask of being a healthcare professional.
Be authentic and perform within boundaries.
I have learnt that as a person, we have many roles to perform. And that each role has it own required "performance" and that it is not necessarily inauthentic to behave differently in different roles.
Can perform and act while being authentic.
Effect of mask-work
Respect for my mask (roles and responsibilities). Awareness, mindfulness, being conscious.
Be more aware of the "mask" I put on when I accept roles with responsibility or authenticity.
Wear my masks respectfully and meaningfully. Be like the artist—totally immersed in our roles and also able to survey ourselves with detached, objective view.
Mask exercise, which made me more aware of our body/gestures speak a lot too. And I need to be mindful about this myself.

*From Workshop 1 participants (n = 10) who offered qualitative responses on these issue to Question 1 and/or Question 2.

Table 4. Illustration of Themes Emerging from the Interviews*

Themes
Congruence of actions and speech and emotions
The importance and need to have appropriate general body language (on top of appropriate facial expressions), aligned to what you say and express.
Our actions and speeches may not always be congruent, as the body may at times, betray the person, and sometimes even we are not aware of this.
Suddenly you are aware of the need to have your body gestures aligned to your emotions.
The workshop has allowed me to see things with a more "outwards" view. For example, it makes me more aware of myself and how I present myself to the world.
I like the activities which required us to wear the mask. It was a good way to make us realise that we can communicate a lot even without the need to speak. It was a lot of fun...and a good reminder...of the importance of forms of communication other than verbal.
Authenticity of acting and performativity and related themes: "The mask is not fake" and the relevance of the mask-work to working as a doctor
[The importance of] authenticity of acting and performativity in a very sensitive healthcare discipline.
Putting on the mask is [not] compromising the genuineness...it is... how we wear the mask.
Mask is not fake. Session was good as it helped me realise the impact on patients when [the doctor is] fake. If they put on a mask and pretend to be caring when they are not, the patients will know. When coming to the clinic, clinicians have to put on a professional role.
The acting out of emotions with a mask on was most challenging but a good learning experience.
Relevance of actor-training to working with patients, colleagues, students
The workshop assists me to...have...self-awareness/more consciousness when I work with my patients or their relatives.
The importance and need to have appropriate...body language... aligned to what you say and express. This is especially useful for conducting difficult conversations with staff and patients.
This workshop helped me to be more sensitive towards the feeling of my patients.
Performance is a part of my role as a doctor.

*No. of interviewees = 6 (all from Workshop 1).

authors conducted 2 interviews each. All interviewees were asked "What was the main feature of the workshop for you?"; "What did you get from the workshop? Personally? Professionally?"; and "Was there anything from the workshop that you have found to be useful in practising in your role as a doctor/nurse (as appropriate)?" In analysing the responses, it was apparent that similar answers were given to each of the questions and for this reason, the responses are presented in Table 4 in relation to the 3 identified themes from a thematic analysis of all 6 interviews, through a "careful reading and re-reading of the data".[7] The following themes were identified as being important to the participants in describing their views about the workshop:

- Congruence of actions and speech
- Authenticity of acting and performativity
- Relevance of actor-training to working with patients, colleagues, students.

See Table 4 for interviewees' statements which illustrate each of these themes.

Discussion

The participants' ratings for Workshop 1 appear to be higher than for Workshop 2 but this could be a function of the difference between rating scales in the questionnaires for the 2 workshops. A difference between a 4-point (without a mid-point) and a 5-point Likert scale may have an effect.[8] There may also be greater reluctance to assign the term "Excellent" rather than "Very Good"—with a consequent shift towards the mid-point. Nevertheless, these ratings indicate a positive response to the activities and the reflection activity in both workshops.

Both workshops were given high ratings on "usefulness", and Workshop 2 was given high ratings on "content", "delivery", and "enjoyment" (responding to questions that

were not asked in Workshop 1). In both workshops there was a range of responses to questions regarding "What have you gained from this workshop?" and "How would you implement/adapt/apply your learning in your professional practice?" Most responses were general such as "be more mindful of my behaviour," "be more self aware," and have "insight into how we as professionals can become conscious of our activities and their impact on our lives." However, there were more specific responses relating to "acting skills" including have "more respect and appreciation for acting as an art. A deeper reflection on issues of what it means to perform a role." There were also responses relating directly to "care for patients" including "Performance as a means to explain and enhance doctor-patient relationship" and greater awareness of the "relationship between doctor and patient (related to patient-empathy)." Many of the comments indicated insights into "body language, communication and the expression of emotion" from the workshops and particularly from mask-work. For example, one comment was that mask-work was an effective "tool" in communication training "to emphasise...body language," and another participant commented that the "mask exercise... made me more aware [that] our body/gestures speak a lot too." Another wrote of the workshop providing a "better understanding of the framework on how to improve and be aware of body language in communication." The workshops also sparked "ideas for teaching communication and self-awareness" and being "more mindful when teaching."

In Workshop 1, the issue of "whether one is authentic when employing acting skills" came to the fore. This is an important issue if we are to claim (as we do) that actor-training improves the performance and effectiveness of clinicians in relating to patients. If acting is simply "to pretend", then "the notion of doctors acting in front of their patients will be repugnant"—as McManus[3] recognises—because we hold authenticity as "an intrinsic good". In our view "authentic" means "genuine, not feigned or false", and "not affected" as it is defined in the Oxford English dictionary (OED).[1] As stated above, this issue was discussed in Workshop 1 in terms of whether "acting" is "putting-on-an-act"—or whether acting is, or can be, a "genuine expression". The other form of this question related to wearing a mask, and a concern about whether the actor was "hiding behind the mask" or the mask "accentuated", in some form, what was real and genuine. It is clear from comments offered (as represented in Table 3) that participants had come to see acting as offering skills that enabled "authentic" and "genuine expression". An example of this is the comment in Table 3 that one "can perform and act while being authentic."

The themes emerging from interviews of 6 Workshop 1 participants supported the tenor of comments from the workshop questionnaires. Interviewees found that they become more aware of congruence, or lack of congruence, between actions, speech and emotions, during the workshop. This carried over, at least for some of the interviewees, to a greater awareness of "body language" in relating to patients and colleagues. Performance in mask also led to explorations of the issue of genuineness of performance, and the discovery that it is not wearing the mask (or putting on a professional role) that is critical but "it is...how we wear the mask."

Whilst—in common parlance—we speak of "hiding behind a mask", participants clearly expressed the view that using a mask within the workshop was a way of understanding and being more aware of "playing" a professional role. For example one participant wrote of "respect for my mask (roles and responsibilities). Awareness, mindfulness, being conscious." The mask, in this workshop, was taken as a metaphor for playing a "role of healthcare worker" and participants clearly saw that one can play the role with respect for the role, and act appropriately within that role, without it being a form of "hiding behind" or inauthenticity. Another participant wrote of being "more aware of the 'mask' [I] put on when I accept roles with responsibility or authenticity" and another, commenting along these lines, wrote that: "[I] wear my masks respectfully and meaningfully." This person advised being "like the artist—totally immersed in our roles and also able to survey ourselves with detached, objective view." This last comment was a reference to statements made in both workshops that the renowned Russian actor-trainer Konstantin Stanislavsky saw the pinnacle of acting as both experiencing oneself fully engaged within a role, whilst at the same time observing oneself as a performer—as if one is looking down on oneself. This apparent "dividing of oneself" is not experienced by an accomplished actor as division, but of supreme mastery and integration.[1,9,10]

This issue did not arise in comments made by participants following Workshop 2. It was an issue of particular importance to one of the participants in Workshop 1—who raised the issue early in the workshop and brought it up in discussion and again in an interview. As facilitators, we encouraged this discussion, when it arose in Workshop 1, because we regard an understanding of mask-work as enabling one to play a role more effectively, and as a major justification for offering acting training to HCPs. Actor-training can address—and take one beyond—what is often perceived as a dichotomy between empathy and analytic knowledge, for HCPs and students in training.[1,11,12] Through training as an actor, one can learn to be fully immersed within a role and empathically relating to other "actors", whilst being at the same time analytic and objective (as we discussed in our previous publication[1]).

Workshop 2 participants (but not Workshop 1) were asked for "Other comments about the Workshop". Whilst some noted that the workshop was "fun," "eye-opening," and "well-prepared," another described it as "different" and involved "difficult learning!" This latter commentator added that "this is experiential." In our view, this comment points to a key difference between an actor-training workshop and many other workshops that are offered to HCPs. We believe that the important learnings can only be absorbed through experiential and embodied activities. They are not primarily conceptual but rather perceptual. One commentator noted that "it is very difficult to relate this to work." Another put a view that "the purpose should be clearer" and a further participant advocated making the "relevance to clinical environment more explicit." Our intention in offering both workshops was to be clear about our purpose and to relate this work to the clinical environment. We can, of course, be criticised for failing to do so—and we continue to look for ways to better achieve those ends. However, we also believe that all the above comments are related. It is difficult learning, because the means for learning are not primarily conceptual but experiential. HCPs are largely trained in conceptual modes although importantly, their work demands a much more engaged and empathic response.

There are few reports in the literature of actor-training for HCPs and these relate to actor-training for medical students rather than practising clinicians.[1,13-16] This is pioneering work therefore. However, in reaching any conclusion about the value of actor-training for HCPs, it needs to be acknowledged that the workshops we report were attended by participants who freely chose to attend and were open to learning through this medium. We make no claim for the effectiveness of actor-training for HCPs or trainees within a course where there may be some degree of compulsion to attend. A further qualification is that any conclusions about the clinician's effectiveness resulting from this training are based on the participants' self-reports.

The aim of these workshops was to provide participants with both skills and an "embodied" understanding, through actor-training, as a basis for expanding the range of their "performativity" (performance skills) and effectiveness in relating to patients. From the participants' comments, it is apparent that participants gained a better understanding of the need for congruency between verbal and non-verbal expression and between their emotional experience and expression. For some participants, there was also a better sense of how others perceive them. There were also the apparent gains from working with masks. For some, the mask offered an expanded way of understanding their professional role, such as for the person who wrote of being "more aware of the 'mask' I put on when I accept roles with responsibility or authenticity". Such comments were validating of key assumptions in running the workshops that "Acting is not to pretend but to express oneself effectively and genuinely" and that "Theatre work, including work with masks, is not to hide but to accentuate" (assumptions that were discussed in our previous paper[1]). On this basis, we believe that our aims in running these workshops were achieved to some considerable extent and that there is a good case for continuing to offer actor-training to doctors and other healthcare practitioners.

Conclusion and Recommendation

We can conclude from participants' responses that the workshops were well received and that there were revelations in understanding and potential changes in approach to "acting in the role" of a doctor, nurse and other healthcare worker. Participants understood that acting is not about hiding but about playing one's role more effectively. Actors are superbly trained in the nuances of observation, body-awareness, and relating effectively to others. This goes beyond mere role-playing and communication training to encompass an embodied understanding that may enable trainees to be more creative and genuine within themselves and, more effective with patients and other staff. We conclude therefore that, whilst further research is warranted, these results support actor-training, offered by an experienced actor or acting teacher, as a means for developing acting skills, self-awareness, and effectiveness of clinicians, trainees and other HCPs, in relating to their patients.

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REFERENCES

1. Macneill P, Gilmer J, Samarasekera DD, Tan CH. Actor training for doctors and other healthcare practitioners: a rationale from an actor's perspective. Global Journal of Arts Education 2014;2:49-55. Available at: http://sproc.org/archives/index.php/gjae/article/viewArticle/3394. Accessed on 19 February 2016.
2. Finestone H, Conter D. Acting in medical practice. Lancet 1994;17:801-2.
3. McManus C. Department of theatrical medicine? Lancet 1994;344:767.
4. Dakin P. The drama of the consultation. Educ Prim Care 2012;23:311-2.
5. Chekhov M. To the actor: On the technique of acting. London & New York: Routledge; 2002. p. 210-15.
6. Lecoq J. The theatre of movement and gesture. Abingdon, England; New York: Routledge; 2006. p. 98,105.

7. Rice P, Ezzy D. Qualitative research methods: A health focus. Melbourne: Oxford University Press; 1999. p. 248.
8. Garland R. The mid-point on a rating scale: is it desirable? Marketing Bulletin 1991;2:66-70.
9. Macneill P. Presence in performance: An enigmatic quality. In: Macneill P, editor. Ethics and the arts. Heidelberg, New York, and London: Springer; 2014. p.137-49.
10. Carnicke SM. Stanislavsky in focus: an acting master for the twenty-first century. 2nd ed. London; New York: Routledge; 2009.
11. Rosenfield PJ, Jones L. Striking a balance: training medical students to provide empathetic care. Med Educ 2004;38:927-33.
12. Macneill PU. Balancing ethical reasoning and emotional sensibility. Med Educ 2010;44:851-2.
13. Baerheim A, Alraek TJ. Utilizing theatrical tools in consultation training. A way to facilitate students' reflection on action? Med Teach 2005;27:652-4.
14. Dow AW, Leong D, Anderson A, Wenzel RP. Using theater to teach clinical empathy: a pilot study. J Gen Intern Med 2007;22:1114-8.
15. Lim BT, Moriarty H, Huthwaite M. "Being-in-role": a teaching innovation to enhance empathic communication skills in medical students. Med Teach 2011;33:e663-9.
16. Lim BT, Moriarty H, Huthwaite M, Gray L, Pullon S, Gallagher P. How well do medical students rate and communicate clinical empathy? Med Teach 2013;35:e946-51.

Are We Working Too Hard?—A Functional Scoring of Orthopaedic Surgeons

Dear Editor,

It is no secret that surgeons are subjected (or subject themselves) to long hours at work, be it in the operating theatre, the clinic, the office, or otherwise. Such a lifestyle is likely to result in health problems in the long run. The mental health of doctors has been extensively studied, with many doctors revealing evidence of psychiatric morbidity.[1,2] This has implications on both the health of doctors and healthcare in general, as burnout can be associated with poorer performance and increased turnover rate of healthcare workers.[3]

For orthopaedic surgeons and trainees especially, it was found that there was a high incidence of reported emotional exhaustion, psychological distress, and burnout.[4-6] Given the positive correlation with work hours, it is worth exploring whether we face the same problem locally.

There have also been surprisingly few studies on the physical health of surgeons. For orthopaedic surgeons, standing long hours in the operating room, applying manual traction, and hammering nails are all part of the job. Such physical demands are sure to take their toll on their health in ways that could possibly be unique to orthopaedic surgeons.[7]

Materials and Methods

We created an anonymous online survey that consisted mainly of questions from the Short Form-36 (SF-36) health survey questionnaire, a validated tool that covers both physical and mental health;[8] and the Patient Health Questionnaire-9 (PHQ-9), a validated depression screening questionnaire.[9] We included questions on hours in surgery, stay-in calls, amount of sleep, and respondent demographics. The survey was disseminated to orthopaedic surgeons and trainees in all public hospitals in Singapore via email. Consent was inferred from completion of the questionnaire.

Ethics approval was obtained from the Institutional Review Board prior to the study.

Results

Of 137 invitations, 67 (48.9%) responses were received. As local norms are not available for SF-36, we compared the scores for the various sections with population norms from the United States.[10] We found that surgeons were significantly (P <0.05) superior in 2 physical domains but poorer in 2 mental domains.

Comparisons were made between the different subgroups of surgeons, namely: gender, marital status, age, appointment, average number of hours spent in surgery after office hours per week, and average number of stay-in calls per week.

The starkest difference was between different genders: females scored significantly poorer (P <0.05) than males in 7 domains. The next significant difference in scores (P <0.05) was the group that operated 10 or fewer hours after office hours, scoring better than the group that operated 11 or more hours, in 7 domains. "Married" respondents scored significantly better than "single" respondents (P <0.05) in 4 domains, while respondents aged above 40 scored significantly better than those aged 40 and below (P <0.05) in 3 domains, and consultants scored significantly better than trainees (P <0.05) in 2 domains. The significant results (P <0.05) are summarised in Tables 1 and 2.

Stratifying by appointment revealed that trainees who operated 10 or fewer hours after office hours scored significantly better (P <0.05) in 5 domains than those who operated 11 or more hours after office hours. The consultants, as expected, scored significantly better (P <0.05) than both groups of trainees, in the same 5 domains. These scores are reflected in Table 3.

Table 1. Comparison of Scores of Surgeons vs the Norm

Section	Surgeons' Score	Norm	*P* Value
Physical functioning	91.0	83.3	<0.05
Role physical	79.6	82.5	0.37
Bodily pain	78.2	71.3	<0.05
General health	62.1	70.8	<0.05
Vitality	54.3	58.3	0.10
Social functioning	76.1	84.3	<0.05
Role emotional	84.6	87.4	0.28
Mental health	73.2	75.0	0.39

Table 2. Significant Scores by Demographics

Section	Demographic Parameter									
	Male	Female	Married	Single	Consultant	Trainee	Age ≤40	Age >40	Surgery After Hours	
									≤10 hours	>10 hours
Physical functioning	91.4	88.3	91.7	88.1	91.7	90.0	90.1	92.9	91.5	88.8
	$P = 0.05$		$P = 0.12$		$P = 0.16$		$P = 0.56$		$P = 0.08$	
Bodily pain	82.5	60.4	82.1	69.2	83.4	74.6	78.0	83.0	84.0	59.4
	$P < 0.05$		$P < 0.05$		$P = 0.13$		$P = 0.35$		$P < 0.05$	
Vitality	80.4	63.7	79.7	71.8	78.5	77.8	76.5	81.8	81.1	64.7
	$P < 0.05$		$P = 0.14$		$P = 0.96$		$P = 0.35$		$P < 0.05$	
Role emotional	64.5	46.3	64.3	52.8	64.4	59.0	59.3	68.3	64.9	49.1
	$P < 0.05$		$P = 0.06$		$P = 0.28$		$P = 0.14$		$P < 0.05$	
Physical functioning	57.4	34.0	57.1	42.8	61.5	44.8	50.4	62.8	58.0	37.5
	$P < 0.05$		$P < 0.05$		$P < 0.05$		$P < 0.05$		$P < 0.05$	
Bodily pain	79.1	56.9	77.5	70.2	78.9	72.4	72.0	85.1	81.6	51.0
	$P < 0.05$		$P = 0.09$		$P = 0.19$		$P < 0.05$		$P < 0.05$	
Vitality	87.1	68.5	86.3	77.6	8.8	79.0	82.8	88.5	88.8	65.2
	$P < 0.05$		$P < 0.05$		$P = 0.07$		$P = 0.33$		$P < 0.05$	
Role emotional	76.6	51.7	77.5	55.9	81.3	62.6	69.0	82.4	76.8	56.7
	$P < 0.05$		$P < 0.05$		$P < 0.05$		$P < 0.05$		$P < 0.05$	

PHQ-9 revealed that 35.4% of surgeons have moderate to severe symptoms of depression. The average score was 12.9, indicating symptoms of minor depression.[9]

A total of 23.9% of surgeons agreed to having contributed to road traffic accidents due to lack of sleep. However, when stratified by the average number of hours spent sleeping per day, the majority of respondents fell into the 5-to-8 hours category, hence we were unable to identify a cutoff point that put doctors at greater risk of road traffic accidents.

Discussion

The good news is the scores of our doctors are not that different from the normal population. In fact, the better Physical Functioning and Bodily Pain scores show that perhaps orthopaedic surgeons know how to take care of their physical health better than the general population, which may normally be expected of doctors.

Table 3. Significant Scores of Trainees Operating ≤10 Hours, Trainees Operating >10 Hours and Consultants

Section	Trainees Operating ≤10 Hours	Trainees Operating >10 Hours	Consultants
Role physical	83.3	60.2	83.4
Vitality	49.3	37.5	61.5
Social functioning	84.0	53.4	78.9
Role emotional	86.6	66.7	88.8
Mental health	66.9	55.5	81.3

After delving deeper into the analyses, we see the darker effects of this industry: overwork causing impaired social functioning, feeling nervous or depressed, and generally poor health. This is especially so when we compare the scores of single doctors and doctors who operated 11 or more hours after office hours per week, against the population norms. These doctors score worse than the general population, especially in the mental health components of SF-36. This may suggest that while younger, single trainees are physically able to cope with the workload their traineeship entails, mental stresses of the job may take their toll. An increased workload has already been shown to be a risk factor for burnout and depression, which in turn leads to increased rates of medical errors.[11-13]

Conversely, we note that the more senior groups, i.e. the consultants, older and married surgeons, fared better when compared against the younger trainees. Thus we may postulate that either older surgeons possess more maturity and mental strength to deal with the rigours of orthopaedic surgery, or the responsibilities of a trainee are tougher than those of a consultant, or both. One thing seems certain — things get better with age (and promotion).

The results for PHQ-9 point to a slightly different conclusion: no significant demographic factor can be

identified to cause depressive symptoms. However, the average score, that suggests symptoms of depression, is also an indication that the toll orthopaedic surgery takes on its doctors is more than just skin (or muscle) deep.

Judging from the SF-36 and PHQ-9 results, it appears that orthopaedic surgery is more mentally than physically demanding, unlike what we thought before. This is perhaps another piece of evidence, to disprove the "twice as strong as an ox, and half as smart" claim.[14]

The poor mental health scores indicate that our doctors, especially our trainees, may be at risk of burnout. However, do note that a portion of our trainees are still part of the old specialist training programme, and hence not subjected to the work hour restrictions that the current residency entails. Working conditions may improve once more of our trainees are forced to keep to more humane hours.

Despite the better scores for the male than the female populations, having 9 female respondents (13.4%) greatly reduces the power of comparison. The reason for a small female surgeon population has previously been explored,[15] with factors such as lifestyle being reasons for women not choosing surgical specialties. However, other reasons, such as its physical nature, may be misconceptions. Our results would perhaps have addressed these misconceptions, but the low population of female respondents prevents us from drawing any conclusions.

Conclusion

The key to happiness seems to be growing old, getting married, and becoming a consultant surgeon as soon as possible. In the meantime, we recommend juniors to avoid operating more than 10 hours after office hours, as this directly affects their health-related quality of life and risk of depression. While drastically improved working conditions may not seem possible at the moment, we hope this study can spur decision-makers to continue to make policy changes, and for further studies to be conducted on the well-being of doctors.

REFERENCES

1. Ramirez AJ, Graham J, Richards MA, Cull A, Gregory WM. Mental health of hospital consultants: the effects of stress and satisfaction at work. Lancet 1996;347:724-8.
2. Shanafelt TD, Balch CM, Bechamps GJ, Russell T, Dyrbye L, Satele D, et al. Burnout and career satisfaction among American surgeons. Ann Surg 2009;250:463-71.
3. Zhang Y, Feng X. The relationship between job satisfaction, burnout, and turnover intention among physicians from urban state-owned medical institutions in Hubei, China: a cross-sectional study. BMC Health Serv Res 2011;11:235.
4. Arora M, Diwan AD, Harris IA. Burnout in orthopaedic surgeons: a review. ANZ J Surg 2013;83:512-5.
5. Sargent MC, Sotile W, Sotile MO, Rubash H, Barrack RL. Stress and coping among orthopaedic surgery residents and faculty. J Bone Joint Surg Am 2004;86:1579-86.
6. Sargent MC, Sotile W, Sotile MO, Rubash H, Barrack RL. Quality of life during orthopaedic training and academic practice. Part 1: orthopaedic surgery residents and faculty. J Bone Joint Surg Am 2009;91:2395-405.
7. Ruitenburg MM, Frings-Dresen MH, Sluiter JK. Physical job demands and related health complaints among surgeons. Int Arch Occup Environ Health 2013;86:271-9.
8. Ware JE. SF-36® Health Survey Update. Available at: http://www.sf-36.org/announcements/Updated_SF36_bookChapter_Sept04.pdf. Accessed on 1 December 2014.
9. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. J Gen Intern Med 2001;16:606-13.
10. 1998 National Survey of Functional Health Status, USA. Available at: http://www.sf-36.org/research/sf98norms.pdf. Accessed on 1 December 2014.
11. Patterson PD, Weaver MD, Frank RC, Warner CW, Martin-Gill C, Guyette FX, et al. Association between poor sleep, fatigue, and safety outcomes in emergency medical services providers. Prehosp Emerg Care 2012;16:86-97.
12. West CP, Tan AD, Habermann TM, Sloan JA, Shanafelt TD. Association of resident fatigue and distress with perceived medical errors. JAMA 2009;302:1294-300.
13. Balch CM, Shanafelt TD, Dyrbye L, Sloan JA, Russell TR, Bechamps GJ, et al. Surgeon distress as calibrated by hours worked and nights on call. J Am Coll Surg 2010;211:609-19.
14. Subramanian P, Kantharuban S, Subramanian V, Willis-Owen SA, Willis-Owen CA. Orthopaedic surgeons: as strong as an ox and almost twice as clever? Multicentre prospective comparative study. BMJ 2011;343:d7506.
15. Nguyen L, Amin NH, Vail TP, Pietrobon R, Shah A. Editorial: a paucity of women among residents, faculty, and chairpersons in orthopaedic surgery. Clin Orthop Relat Res 2010;468:1746-8.

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Letter to the Editor

The Prevalence of Post-Traumatic Stress Disorder in Intensive Care Unit Staff and the Common Coping Strategies Used

Dear Editor,

The medical personnel of the intensive care unit (ICU) encounter patients who are critically ill, have severe injuries, or require multiple life-sustaining interventions on a daily basis. Working in a stressful environment such as the ICU can be highly rewarding, but it may also have detrimental effects on the physiological and psychological well-being of the staff.[1,2] A study by Mealer et al (2007) showed a greater prevalence of post-traumatic stress disorder (PTSD) symptoms among ICU nurses compared to general nurses while a study on ICU personnel reported that out of 144 ICU nurses who dealt with trauma and critically ill patients, 88% had suffered from intrusive symptoms, 75% from symptoms of hyperarousal, and 41% eventually developed PTSD.[3] Azoulay et al (2013) showed that high burnout scores correlate with vulnerable personality, low job satisfaction, and high degree of job stress.[4]

We hypothesised that ICU staff may be at increased risk for developing symptoms of PTSD and other psychological disorders, and have negative coping strategies. Our aim was to determine the prevalence of PTSD symptoms among ICU staff in Singapore and to determine the common coping strategies employed.

Materials and Methods

Study Design and Materials

Our methodology was a cross-sectional survey using validated survey instruments. This study was approved by the Institutional Review Board (IRB). The questionnaire incorporated the Post-Traumatic Symptom Scale-10 (PTSS-10), Hospital Anxiety and Depression Scale (HADS) and COPE Inventory, and was administered over 30 days. The PTSS-10 looked at the presence of the following post-traumatic stress symptoms: sleeping difficulties, nightmares, feeling dejected or downtrodden, jumpiness or startled reactions, the need to withdraw from others, irritability and agitation, frequent mood swings, bad conscience, feelings of guilt, fear of places that remind an individual of the place that he/she works in, and muscular tension. Scores of 1 to 2 were considered mild, scores of 3 to 4 were considered moderate, and 5 or more were considered as a strong reaction.

Participants and Sampling

We studied all doctors and nurses working in the medical and surgical ICUs of a regional hospital in Singapore. This was a voluntary and anonymous survey. The sampling method was based on random voluntary sample and the questionnaire was provided to all participants and collected in a box placed in the institution's ICU.

Setting

Our institution's ICU has a mix of intensive care and high dependency patients. The ICU has a 1:1 nurse-to-patient ratio and a 1:2 ratio in the high dependency unit (HDU). Nurses work in shifts while doctors have a rotational on-call schedule. It generally has a high APACHE II score patient population. The case mix consists of adult medical and surgical critically ill patients.

Data Collection

We collected data identifying common stressors associated with working in the ICU as well as through a Life Events Checklist. The questionnaire also included the HADS, which consists of 2 subscales that evaluate symptoms of depression and anxiety. A score of 8 or greater is suggestive of the possible presence of anxiety or depression.

Another outcome measure was to identify common coping methods used to overcome stress, anxiety and depression. To this end, we used the COPE Inventory which was developed to assess a broad range of coping responses. Twenty-eight questions were asked which looked at different coping strategies and these were broadly divided into adaptive and maladaptive coping methods. Demographic data was also collected from the questionnaire. ICU stressors as mentioned in prior literature were listed.[5]

Statistical Analysis

The data was entered and analysed in SPSS™. We estimated a sample size of at least 100 participants from ICU staff in 30 days in order to obtain an 80% power for our study.

Results

Demographics

A questionnaire was distributed to 107 nurses and doctors in the ICU of a regional hospital in Singapore. We had a 94% response rate. The respondents consisted predominantly of nurses 87% (n = 90) and doctors 13% (n = 14); 83% were female (n = 88) and 17 % were men (n = 18). The mean age was 31.7 (SD = 7.3); ranging from 22 to 63 years. A total of 59% of participants had less than 5 years of experience.

Our questionnaire looked at aspects of ICU care that healthcare professionals find stressful. More than 86 % of them found working in ICU to be stressful. Cumulatively, more than 80% of the staff found dealing with difficult relatives, traumatic injuries and performing futile care to be highly stressful. Ninety-two of the staff was also unhappy with the inadequate staff-to-patient ratio (Table 1).

Table 1. Stress-Related Activities in ICU

Stressful Situations Reported by Healthcare Professionals	Percentage
General work in the ICU	86%
Dealing with very sick/dying patients	92%
Dealing with severe traumatic injuries	94%
Handling the bodies of deceased patients	59%
Inadequate staff-to-patient ratio	92%
Maintaining an amicable relationship with nurses	57%
Maintaining an amicable relationship with doctors	60%
Performing “futile” care	80%
Encountering combative patients	92%
Encountering patients with difficult relatives	96%
Involvement with end-of-life care	72%
Preforming cardiopulmonary resuscitation	80%

ICU: Intensive Care Unit

Post-Traumatic Stress Symptoms

On the PTSS-10, 28% of staff had experienced nightmares in relation to their work and 25% have suffered from anxiety attacks when they thought about their work experiences in the ICU as shown in the HADS scale. On this scale, 67% of participants scored 1 to 2 (mild), 29% scored 3 to 4 (moderate), and only 4% scored 5 or more indicating a relative strong reaction. In all, 33% of staff suffered from significant post-traumatic symptoms.

Healthcare professionals reported stress in the following situations: general work in the ICU, dealing with difficult relatives and traumatic injuries, performing futile care, and poor staff-to-patient ratios. There was no significant difference between gender or occupation on the PTSS. However, there was a significant difference for those who were younger ($P = 0.007$). Those with more years of working experience reported fewer symptoms ($P = 0.01$). Shift work also had a significant impact ($P = 0.02$) on reported symptoms (Table 2).

Anxiety Depression Score

This was measured using HADS. Eleven percent of the staff was found to have significant anxiety symptoms and

Table 2. Statistical Test of Outcomes, PTSS-10, COPE Maladaptive and Adaptive Scales Against Demographics

	PTSS-10		COPE Maladaptive Scale		COPE Adaptive Scale	
	Mean	*P* Value	Mean	*P* Value	Mean	*P* Value
Gender		0.15		0.98		0.84
Male	22 ± 11		12 ± 4		49 ± 11	
Female	26 ± 13		12 ± 4		51 ± 10	
Occupation		0.99		0.34		0.68
Doctor	25 ± 12		11 ± 2		49 ± 13	
Nurse	26 ± 13		12 ± 4		51 ± 9	
Age (cutoff: 30 years old)		0.007		0.09		0.71
Younger than 30 years old	28 ± 12		13 ± 3		50 ± 11	
Older than 30 years old	23 ± 12		12 ± 4		51 ± 9	
Years of experience		0.02		0.24		0.75
Less than 5 years	29 ± 13		13 ± 3		51 ± 10	
More than 5 years	23 ± 10		12 ± 4		51 ± 10	
Night shift		0.02		0.96		0.49
1 to 5 days	24 ± 10		13 ± 4		50 ± 11	
More than 5 days	30 ± 14		12 ± 3		52 ± 10	

PTSS-10: Post-Traumatic Symptom Scale-10

Table 3. Hospital Anxiety and Depression Scale (HADS) Results

Hospital Anxiety and Depression Scale (HADS)	Anxiety	Depression
Normal (0 – 7)	64%	74%
Borderline (8 – 10)	25%	15%
Abnormal (11 – 21)	11%	12%

12% had significant depressive symptoms. Gender, night shift work, and experience (in years) had no effect on the HADS score (Table 3). This is considerably higher compared to point prevalence of depression in the general Singapore population which is between 3.6 to 7%. Doing more than 5 night shifts was also a problem (Table 2).

As evident, by far, the majority of staff (92%) adapted positively with a large number resorting to active coping, positive reframing of religion, and acceptance (the actual questions were worded more simply), while a small number (3 to 8%) fell into negative coping means such as substance abuse, denial, etc. Gender, age, occupation, years of experience and night shift work did not have any effect on coping methods.

Discussion

PTSD is a complex mental illness that results from an individual's response to an experienced or witnessed traumatic event, actual death, perceived threat of death or serious injury that results in extreme fear, helplessness or horror.[6] No large studies are present in Singapore and certainly not for prevalence in ICU staff.[7,8] Our study explores the psychological manifestations of coping with a busy ICU environment on staff members including doctors and nurses of both genders. Our hospital has a Staff Crisis Programme where peer supporters provide emotional support and are trained to listen without judging.[9,10]

In addition to crises intervention schemes and regular support group intervention, avenues for staff to find time for non-medical relaxation techniques such as yoga and music therapy must be considered. Frequent rotation out of the ICU may also be explored. Debilitating illness can also inhibit the individual's life. The level of success one has at his or her place of employment depends on many factors including the level of impairment and support outside and inside the work environment. Another facet could be to make people aware of this phenomenon and make it easy for staff to seek help.[11,12]

Although at times the experiencing of symptoms is unavoidable, crisis intervention is a useful platform for screening, reducing acute distress, fostering group cohesion, providing psychoeducation and information, and anticipatory guidance.[13] As caring organisations, institutions have a role in assisting affected employees in dealing with the psychological aftermath of their trauma with sensitivity, understanding and support at every staff level. Despite the high levels of PTSD, the ICU staff had a low rate of negative coping methods.

Limitations

Our limitations are a relatively small sample size and more nurses than doctors who voluntarily filled the form. The scales we used are meant to screen for PTSD and depression amongst patients and not healthcare workers; neither are they meant for a proper diagnosis as this still requires a consultation with a psychiatrist. The validity of anonymous, self-reported stress symptoms are also a limitation, especially when reporting on the use of coping methods.

REFERENCES

1. Acker KH. Do critical care nurses face burnout, PTSD, or is it something else?: getting help for the helpers. AACN Clin Issues Crit Care Nurs 1993;4:558-65.
2. Yehuda R. Post-traumatic stress disorder. N Engl J Med 2002;346:108-14.
3. Myhren H1, Ekeberg O, Stokland O. Job Satisfaction and Burnout among Intensive Care Unit Nurses and Physicians. Crit Care Res Pract 2013;2013:786176.
4. Azoulay E, Pochard F, Kentish-Barnes N, Chevret S, Aboab J, Adrie C, et al. Risk of post-traumatic stress symptoms in family members of intensive care unit patients. Am J Respir Crit Care Med 2005;171:987-94.
5. Stechmiller JK. The nursing shortage in acute and critical care settings. AACN Clin Issues 2002;13:577-84.
6. Javidi H, Yadollahie M. Post-traumatic Stress Disorder. Int J Occup Environ Med 2012;3:2-9.
7. Badger JM. Understanding secondary traumatic stress. Am J Nurs 2001;101:26-32.

8. Kerasiotis B, Motta RW. Assessment of PTSD symptoms in emergency room, intensive care unit, and general floor nurses. Int J Emerg Ment Health 2004;6:121-33.
9. Embriaco N, Azoulay E, Barrau K, Kentish N, Pochard F, Loundou A, et al. High level of burnout in intensivists: prevalence and associated factors. Am J Respir Crit Care Med;175:686-92.
10. Mealer ML, Shelton AL, Martin GS, Burnham EL, Odom SE, Moss M. The prevalence of post-traumatic stress disorder is increased among intensive care unit nurses [abstract]. Proc Am Thorac Soc 2006;3:A833.
11. Jonsson A, Segesten K, Mattsson B. Post-traumatic stress among Swedish ambulance personnel. Emerg Med J 2003;20:79-84.
12. Weisaeth L. Torture of a Norwegian ship's crew: the torture, stress reactions and psychiatric after-effects. Acta Psychiatr Scand Suppl 1989;355:63-72.
13. Thulesius H, Hakansson A. Screening for posttraumatic stress disorder symptoms among Bosnian refugees. J Trauma Stress 1999;12:167-74.

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Dermatologic Screening in an Elderly Community with Low Socioeconomic Status in Singapore

Dear Editor,

The elderly population is predisposed to a myriad of skin conditions such as xerosis and malignancy. The World Health Organisation (WHO) has defined elderly as those above age 50.[1] In Singapore, 1,266,998 people (18.5% of the population) were above the age of 50 in 2014.[2] Of which, 3.2% stay in 1- and 2-room flats including rental flats. The Singapore public rental policy indicates that individuals can qualify for rental flats if their monthly income is less than 1500 SGD and they have no child who is able to provide accommodation.[3] Little is known about the dermatologic health of the elderly community with low socioeconomic status (SES) living in rental flats. Therefore, dermatologic screening was performed on this vulnerable group by 3 dermatology nurses to unravel the unmet needs.

Materials and Methods

Skin assessment was conducted by dermatology nurse clinicians from the Singapore National Skin Centre (NSC) on 7 November 2014. The elderly—who live in rental flats in the Bedok estate—are largely activities of daily living (ADL)-independent. This was an event conducted with the Thye Hua Kwan (THK) Radiance Senior Activity Centre (SAC) at Bedok. All elderly residents aged 50 and above were invited for the screening session.

The data collected included patient demographics and nurse-clinician assessment of general appearance, skin, hair and nail conditions. Data was analysed using Stata 13. Descriptive statistics was used to describe the participants' profile and clinical data.

Results

Thirty-three individuals participated in the skin assessment. The age ranged from 58 to 90, with a mean of 77.00 (7.52). Most of the elderly who participated were females (n = 26, 78.79%). Of the 33 elderly, 7 (21.2%) were identified as requiring follow-up care with a medical practitioner (Table 1).

Xeroderma

The most common skin problem faced by the elderly was xeroderma—25 (75.76%) were clinically assessed as having abnormally dry skin. Xeroderma was significantly associated with age. Elderly with xeroderma (mean: 78.45; SD = 5.93) were older than those without xeroderma (mean = 72.13; SD = 10.12; T = -2.23, P = 0.03).

Pigmented Lesions

Pigmented lesions were found to be the next most common skin problem. Twenty-two (66.67%) had pigmented lesions on the upper limbs, 4 (12.12%) on the lower limbs, and 1 (3.03%) on the trunk.

Discussion

This dermatologic screening offers a glimpse into the skin condition of the Singapore elderly population with a low SES. As expected, it highlights a lack in dermatological care as demonstrated by a significant percentage (21%) assessed to be requiring a review by medical practitioner. However, no prior screening programme exists. The socioeconomic and education barrier can result in decreased access to healthcare and self-care behaviour. In those above 65, nearly 8 in 10 elderly had below secondary qualifications in Singapore.[1]

Xeroderma was the most common skin condition encountered. Skin barrier functions are impaired with decreased stratum corneum hydration, sebum production

Table 1. Patients with Conditions that Require Further Evaluation by Medical Practitioners

Patient No.	Age	Gender	Skin Disease
1	63	Male	Pedunculated nodule on the nose
2	64	Female	Paronychia on the right middle finger
3	69	Male	Severe itchy rash over bilateral arms
4	73	Female	Severe itch that affects sleep
5	76	Female	Nodule on the right upper eye lid affecting vision
6	85	Female	Pedunculated 1.5 cm nodule on right jaw
7	90	Female	1 cm nodule on forehead

and increased transepidermal water loss.[4] As a result, dry skin can cause pruritus, excoriations and increased risk of skin infections. Taking this opportunity, we educated them on the importance of regular application of moisturisers to restore the skin barrier functions.

Pigmented lesions such as seborrheic keratosis and solar lentigines were found in a significant percentage of the elderly. Lesions suspicious of actinic keratosis and skin cancers were screened and referred for further evaluation by medical practitioners. In Singapore, the Singapore Cancer Registry ranks skin cancer as the sixth most frequent cancer in both men and women in the period 2009 to 2013.[5] However, skin cancer screening is little emphasised. This is especially vital in the less educated elderly, because they tend to place little attention to their skin care.

Even though this pilot screening programme is limited by sample size, it is instrumental in our understanding of the dermatological needs of the elderly community with low SES. In Singapore, there is frequent screening for diseases such as hypertension, diabetes, and breast/colon cancer, yet there is few screening for skin problems. Globally, the incidence of skin cancers is also on the rise, with 2 to 3 million non-melanoma skin cancers and 132,000 melanoma skin cancers being diagnosed annually.[6] Asteatosis and asteatotic eczema had a prevalence of 70.5% and 16.4% in the elderly population in a recent study on Japanese elderly population.[7] This corroborates our findings with a similar prevalence. We encourage future larger screening programmes and education to improve the skin health of this population.

One of the limitations of our study was the inability to follow-up on the diagnosis of the 7 patients who required follow-up care with a medical practitioner. The centre manager of the THK Radiance SAC was informed and tasked with the follow-up of the individuals. However, we were unable to retrieve the final diagnosis from polyclinics and dermatologists due to medical confidentiality. Future studies could attempt to follow-up on the outcome of the elderly to evaluate the population which require specialised medical attention.

There is a need for more attention to the skin health of the elderly, as a breech in skin barrier can potentially lead to infections and other chronic skin problems. Dermatology nursing professionals can play an active role in screening and education.[8] They can teach the elderly simple yet important skin care habits such as regular application of moisturisers after bath, use of sun protection devices such as umbrella and clothing or application of sunscreen, and to seek medical attention when they notice abnormal lesions on their skin.

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REFERENCES

1. World Health Organisation. Definition of an older or elderly person. Available at: http://www.who.int/healthinfo/survey/ageingdefnolder/en/. Accessed on 22 June 2015.
2. Department of Singapore Statistics. Population trends 2014. Available at: http://www.singstat.gov.sg/docs/default-source/default-document-library/publications/publications_and_papers/population_and_population_structure/population2014.pdf. Accessed on 22 June 2015.
3. HDB InfoWEB: Eligibility conditions for renting a flat: Renting A Flat: Direct from HDB (Public Rental Scheme). Available at: http://www.hdb.gov.sg/fi10/fi10323p.nsf/w/RentDirectHDBEligibility?OpenDocument. Accessed on 12 December 2014.
4. Berger TG, Shive M, Harper GM. Pruritus in the older patient: a clinical review. JAMA 2013;310:2443-50.
5. Singapore Cancer Registry Interim Annual Registry Report Trends in Cancer Incidence in Singapore. Available at: https://www.nrdo.gov.sg/docs/librariesprovider3/Publications-Cancer/trends-in-cancer-incidence-in-singapore-2009-2013-interim.pdf?sfvrsn=0. Accessed on 18 June 2015.
6. World Health Organization. Ultraviolet radiation and the INTERSUN Programme. Available at: http://www.who.int/uv/faq/skincancer/en/index1.html. Accessed on 18 June 2015.
7. Kimura N, Nakagami G, Takehara K, Miura Y, Nakamura T, Kawashima M, et al. Prevalence of asteatosis and asteatotic eczema among elderly residents in facilities covered by long-term care insurance. J Derm 2013;40:770-1.
8. Oliveria SA, Nehal KS, Christos PJ, Sharma N, Tromberg JS, Halpern AC. Using nurse practitioners for skin cancer screening: a pilot study. Am J Prev Med 2001;21:214-7.

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Letter to the Editor

Nerve Transfer for Elbow Extension in Obstetrical Brachial Plexus Palsy

Dear Editor,

The aim of this paper is to demonstrate the option of triceps muscle restoration by means of selective neurotisation of the radial nerve in children suffering from obstetrical brachial plexus palsy (OBPP) during their early years of life.

Early nerve surgery, which includes both brachial plexus reconstruction and nerve transfers, is generally accepted as the best option for treating children suffering from severe OBPP in their first months of life. As a matter of fact, nerve surgery is performed in order to achieve a higher potential of sensory and motor recovery in those children who would otherwise be doomed to an unfavourable outcome.[1,2]

Despite the option for early nerve surgery during growth, there is a large group of patients who are still showing signs of unsatisfactory recovery of upper limb function. In the said patients, the muscles are seldom completely denervated due to some regeneration of axons across the neuroma. Consequently, nerve transfers should be considered in these cases, keeping in mind that nerve surgery performed later than the first months of life, especially when nerve transfers are done in the following years, should be considered as a real delayed surgery, because nerve surgery should be performed as early as possible.[3,4]

The restoration of shoulder abduction and external rotation, elbow flexion, and prehension are the main goals of brachial plexus repair in infants, while elbow extension recovery has not been emphasised enough in the literature. However, a strong triceps muscle is fundamental to stabilise the elbow and allow greater reach. Wrist extension is also useful for a better grasp.

We present a case series of 10 patients, who underwent nerve surgery for restoration of elbow extension by means of neurotisation of the radial nerve in different ages after birth palsy (Table 1).

Materials and Methods

Given that neurotisation in brachial plexus reconstruction is a well-known procedure that has been used for years, Institutional Review Board approval was not required. However, an informed consent was obtained from each patient, particularly supported by clear explanation of the risks and benefits.

Average age at surgery was 3.3 ± 1.87 years (range, 0.8 to 5.5). In all cases, we performed neurotisation: in 5 cases, we transferred the third, fourth and fifth intercostal nerves to the radial nerve; in 4 cases, the fascicles of ulnar nerve for flexor carpis ulnaris were connected to the radial nerve; and in 1 case, either the spinal accessory nerve and the intercostal nerves were transferred, the first to the branches of the radial nerve for the triceps muscle, and the second to branches of the radial nerve for the wrist extensor muscles. Neurotisation by intercostal nerves was for those who presented a plexus palsy involving the inferior roots.

All the patients were evaluated by: clinical examination, triceps muscle sonography, magnetic resonance imaging (MRI) of the brachial plexus and electrophysiological examination to identify possible muscular denervation. A complete denervation of the triceps muscle was considered as a basis for exclusion from surgery.

One of the main goals of the neurotisation procedure is to achieve a functional result, preventing the loss of previous functions, even if those might be minimal. For that reason, during surgery, an accurate stimulation of the nerve trunk is performed, leaving the nerve fascicles untouched, which in turn presents an electrical response. On the other hand, nerve fascicles giving a minimal or an absent contraction of the muscle under electrical stimulation should be neurotised.

Surgery was performed under general anaesthesia without myorelaxation. A curvilinear skin incision was carried out in the anterior part of the axillary folder extended towards the breast in order to elevate intercostal nerves, or downward along the arm when the cubital nerve had to be dissected. The third, fourth and fifth intercostal nerves were isolated along the inferior part of the ribs and after section, the nerves were elevated and pulled backwards to connect them to the radial nerve stump that was already prepared, as a whole or in part.

Conversely, after the identification of the ulnar nerve at a proximal third of the arm, the fascicles of the ulnar nerve assigned to the flexor carpi ulnaris muscle were identified by means of intraoperative electrical stimulation and after resection, were passed through the axillary folder in order to reach the branches of the long head of the triceps muscle directly or with interposition of grafting.

Table 1. Case Series of Patients

Patients	Original Injury	Previous Surgery	Residual Funzional Deficit	Goal of Surgery	Age at the Time of Nerve Transfer	Donor Nerve	Recipient Nerve	Outcome*
Case 1	C5-C6-C7	No	Elbow extension	Triceps and extensor carpi radialis recovery	5 months	3-4-5 intercostal nerves	Radial nerve branch for long head of triceps	Fair
Case 2	C5-C6-C7	No	Elbow and wrist extension	Triceps recovery	8 months	3-4-5 intercostal nerves	Radial nerve branches for long head of triceps and estensor carpi radiali	Good
Case 3	C5-C6-C7	No	Elbow extension	Triceps recovery	4 years and 11 months	Branch of ulnar nerve to flexor carpi ulnari	Radial nerve branch for long head of triceps	Good
Case 4	C5-C6-C7	No	Elbow extension	Triceps recovery	5 years and 5 months	3-4-5 intercostal nerves	Radial nerve branch for long head of triceps	Good
Case 5	C5-C6-C7-C8-T1	No	Elbow extension	Triceps and extensor carpi radialis recovery	3 years and 7 months	3-4-5 intercostal nerves and accessory spinal nerve	Radial nerve branches for long head of triceps and estensor carpi radiali	Good
Case 6	C5-C6-C7	No	Elbow extension	Triceps recovery	2 years and 6 months	Branch of ulnar nerve to flexor carpi ulnari	Radial nerve branch for long head of triceps	Good
Case 7	C5-C6-C7	No	Elbow extension	Triceps recovery	4 years and 11 months	Branch of ulnar nerve to flexor carpi ulnari	Radial nerve branch for long head of triceps	Good
Case 8	C5-C6-C7	No	Elbow extension	Triceps recovery	4 years and 7 months	Branch of ulnar nerve to flexor carpi ulnari	Radial nerve branch for long head of triceps	Good
Case 9	C5-C6-C7	No	Elbow and wrist extension	Triceps recovery	8 months	3-4-5 intercostal nerves	Whole radial nerve	Fair
Case 10	C5-C6	No	Elbow extension	Triceps recovery	3 years and 2 months	3-4-5 intercostal nerves	Radial nerve branch for long head of triceps	Good

*Outcome has been evaluated by means of the Medical Research Council Scale (Good >M4, Fair M4-/M3+ and Bad <M3).

A single patient underwent surgery using a posterior approach and by means of sural nerve grafting. In the remaining 3 cases, a simultaneous exposure of the ulnar and radial nerves in the axillary folder was carried out, obtaining a direct nerve suture without grafting. All the nerve coaptations were constantly performed by means of 10/0 stitches and fibrin glue.

Results

We revaluated all the patients by the Scale of Medical Research Council. Average follow-up was 3.2 ± 0.85 years (range, 2.5 to 4.6). The results were considered: good for functional outcome >M4, 8 cases; fair for functional outcome M4-/M3+, 2 cases; and bad for functional outcome <M3, no one. The 2 fair cases were total brachial plexus palsy treated by intercostal neurotisation.

Discussion

Elbow extension recovery can be obtained with the repair of 2 specific branches leading to the long head of the triceps muscle. Some publications have illustrated satisfactory results in radial nerve repair using the intercostal nerves,

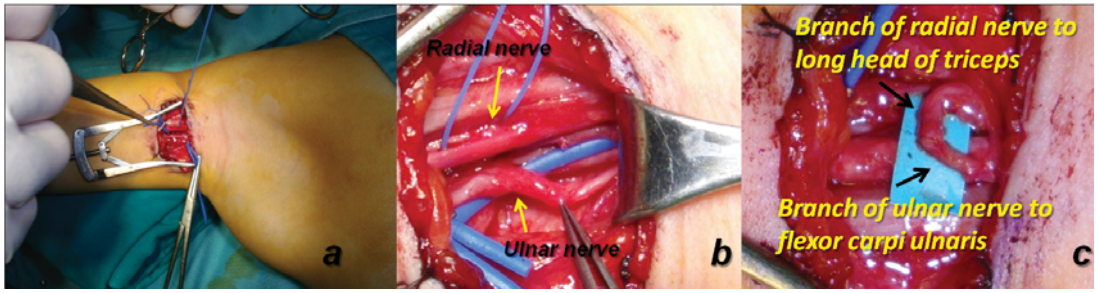

Fig. 1. At a and b, Microsurgical exposure of radial and ulnar nerves at the axillary fold. At c, two branches of the ulnar nerve leading to flexor carpi ulnaris muscle were directed to the branches of the radial nerve leading to the triceps muscle by means of direct nerve suture, without grafting.

despite the fact that the musculo-cutaneous nerve constantly demonstrates a higher level of recovery.[5-7] In our experience of radial nerve neurotisation (5 cases treated to date) by means of intercostal nerves, we have always achieved good results (>M3 +).

Despite the fact that deformities of the chest and the spine in using intercostal nerves are often claimed, we have not observed those shortcomings. In fact, the surgeon should be aware of the risk of damaging the growing structures, which might lead to spine or thoracic deformities as sometimes has happened in thoracic surgery. The potential damage of the vertebral or costal physis would be caused by the vast ribs wide opening or by the extensive denervation of intercostal nerves. Actually, while elevating the intercostal nerves, we should always try to spare the surrounding tissues, avoiding extensive dissection. Thoroughly dissecting intercostal nerves with minimal incision, especially avoiding excessive stretching apart of the ribs, would be a solution to avoiding skeletal deformities during growth.

In patients without any involvement of the lower roots, we consider the ulnar nerve fascicles to be the number one choice for delayed repair of the radial nerve (Fig. 1). Conversely, when the ulnar nerve is impaired, the intercostal nerves always represent a good option for restoring elbow extension (Fig. 2).

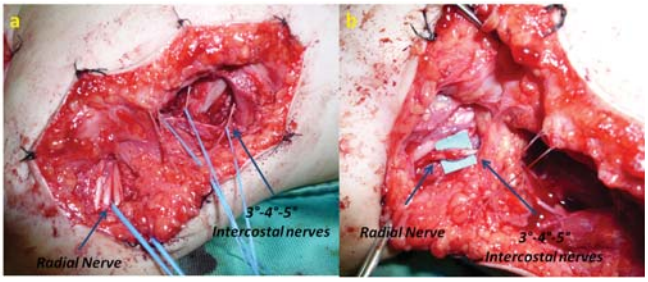

Fig. 2. When the ulnar nerve is impaired, the intercostal nerves always represent a good option for restoring elbow extension. In a), surgical exposure of radial nerve at the axillary folder and 3° and 4° intercostal nerves dissection is shown and in b), neurotisation of the intercostal nerves into the radial nerve is shown.

Objections deriving from the selective neurotisation procedure are the exhaustion of a prolonged denervated muscle and the time limit in which the nerve transfers should be performed. Actually, electromyographic studies may offer further indications, but the point to be considered in OBPP is that a complete denervation of the muscles rarely occurs. More often, in-continuity neuroma allows for recording some neurogenic potentials (i.e. late fibrillation potentials). Those are expressions of the muscle vitality.[8,9]

Through analysing our case studies, good average outcome has been reached, despite the amount of time elapsed since the nerve lesion. In fact, 8 in 10 cases have achieved a functional muscle strength (M4) of the triceps muscle. The explanation of the discrepancy between the results in children and in adults might stem from both prolonged nerve regeneration in childhood, in which residual muscle vitality is maintained despite the absence of functional motion, and the augmentation of residual triceps function, otherwise too weak for motion.

Another factor might be the short distance from the site of nerve coaptation to the target organ. Thus, the most critical point is the age at which such nerve surgery is indicated, particularly because it is difficult to hypothesise the time limit for performing a delayed neurotisation procedure of triceps muscle. Our data has also demonstrated that the percentage of negative outcomes did not increase in the event of a child being older. As a matter of fact, some positive outcomes have been recorded, regardless of the child's age at the time of surgery.

We are aware of the short follow-up of patients treated by means of nerve transfer for triceps recovery. However, those children have not demonstrated significant deformities, even if they are not fully grown. Considering the time elapsed since the obstetrical lesion and the prolonged muscular denervation, it is difficult to define a timeline beyond which surgery should be excluded. Having successfully treated children up to about 6 years of life, we do state that up until 6 years of age, late nerve surgery could be deemed acceptable. However, this does not rule out the possibility of surgery

on children of an older age. On the other hand, in general, for the upper limb but also specifically for elbow function restoration, the onset of elbow joint deformity and anterior soft tissue retraction may add further functional limitation.

Conclusion

Patients with a lack of recovery of elbow extension, due to the palsy of muscles innervated by the posterior cord of the brachial plexus, are in need of selective repair of deficient muscular function.

To restore elbow extension, one possible solution is to reinnervate motor branches of radial nerve to the triceps muscle, in the hope of obtaining good functional results. Depending on the severity and extension of brachial plexus lesion, the radial nerve can be neurotised by means of intercostal nerves when the palsy involves the whole brachial plexus (thus inferior roots are damaged), while in upper or three radicular palsy, the use of fascicles of the ulnar nerve (modified Oberlin's procedure) is advisable.[10]

REFERENCES

1. Gilbert A, Tassin JL. Surgical repair of brachial plexus in obstetric paralysis. Chirurgie 1984;110:70-5.
2. Hale HB, Bae DS, Waters PM. Current concepts in the management of brachial plexus birth palsy. J Hand Surg Am 2010;35:322-31.
3. El-Gammal TA, El-Sayed A, Kotb MM, Saleh WR, Ragheb YF, el-Refai O. Delayed selective neurotization for restoration of elbow and hand functions in late presenting obstetrical brachial plexus palsy. J Reconstr Microsurg 2014;30:271-4.
4. Sénès FM, Catena N, Sénès J. Nerve Transfer in Delayed Obstetrical Palsy Repair. J Brachial Plex Peripher Nerve Inj 2015;10:e2-e14. Available at: https://www.thieme-connect.com/products/ejournals/abstract/10.1055/s-0035-1549367. Accessed on 29 May 2016.
5. Terzis JK, Kokkalis ZT. Restoration of elbow extension after primary reconstruction in obstetrical brachial plexus palsy. J Pediatric Orthop 2010;30:161-8.
6. Doi K, Sakai K, Kuwata N, Ihara K, Kawai S. Reconstruction of finger and elbow function after complete avulsion of the brachial plexus. J Hand Surg Am 1991;16:796-803.
7. Goubier JN, Teboul F, Khalifa H. Reanimation of elbow extension with intercostals nerves transfers in total brachial plexus palsies. Microsurgery 2011;31:7-11.
8. Raimbault J. Electrical Assessment of Muscle Denervation. In: Terzis J, editor. Microreconstruction of Nerve Injuries. Philadelphia: WB Saunders Co; 1987. p. 211-21.
9. El-Gammal TA, Abdel-Latif MM, Kotb MM, El-Sayed A, Ragheb YF, Saleh WR, et al. Intercostal nerve transfer in infants with obstetric brachial plexus palsy. Microsurgery 2008;28:499-504.
10. Oberlin C, Béal D, Leechavengvongs S, Salon A, Dauge MC, Sarcy JJ. Nerve transfer to biceps muscle using a part of ulnar nerve for C5-C6 avulsion of the brachial plexus: anatomical study and report of four cases. J Hand Surg Am 1994;19:232-7.

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