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"Sound, sound the clarion, fill the fife!
Throughout the sensual world proclaim,
One crowded hour of glorious life
Is worth an age without a name."

Thomas Osbert Mordaunt (1730 – 1809)
British officer and poet

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Free Papers

Editorial

Climate Change and Infectious Diseases: The Next 50 Years

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Introduction

It is accepted that the world is warming and driving most of "climate change"; but while the science is "in", the reasons and required interventions sadly remain debated and political. The relationship between climate change and its environmental and social manifestations is complex and brings about diverse adverse risks to human health. Global Climate Change Week—from October 15 to 21—is a time to promote awareness and discussion between academics, policymakers and broader communities to address future climate change actions and solutions.[1]

Projected increases in annual temperatures, rainfall and the frequency of extreme weather events will have direct and indirect repercussions on the environment in which pathogens, vectors, and hosts interact. Directly, infectious pathogens require suitable environments to thrive and ultimately cause human disease. Changes to the environment can further support pathogen survival and with that, the frequency and severity of disease (Fig. 1). Human-induced climate change is just one of the numerous global-scale changes that will affect human health. Indirectly, human factors such as unplanned urbanisation will result in a significantly higher proportion of populations in the urban setting, providing a more favourable environment for pathogens to thrive and for subsequent transmission to humans—whether it be from other humans, animals, vectors or directly from the environment.

Climate Change in Southeast Asia

By 2080, sea levels are expected to rise by as much as 40 cm.[2] Southeast Asia is particularly vulnerable due to its low-lying terrain and long coastlines. More than 100 million people—mostly in East and Southeast Asia—currently live within 1 m of sea level[3] and several large cities including Bangkok, Manila, Ho Chi Minh City and Jakarta are at risk as sea levels rise. In Vietnam, 18 million people currently reside on the Mekong River Delta. The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report predicted that by 2050, rising sea levels could directly displace 7 million of these residents.[4]

In Southeast Asia, surface air temperatures are expected to increase by 2°C by 2060 and as much as 5°C by 2098. In Singapore, the annual mean temperature has increased from 26.6°C in 1972 to 27.7°C in 2014. Rainfall has intensified with an increase in annual average rainfall from 2192 mm in 1980 to 2727 mm in 2014.[5] A rise in average precipitation will result in wetter climates spreading over larger land masses.[6] In Indonesia—which experiences a monsoon wet season and a dry season—there is projected increased rainfall during the rainy seasons and up to a 75% decrease during the dry season,[7] increasing the chances of both flooding and droughts.

Vector-borne Disease

The epidemicity of disease vectors, such as mosquitoes and sand flies are highly climate sensitive so alterations to the geographical and seasonal distribution of diseases they transmit could change considerably. Malaria, dengue, Zika, and Japanese B encephalitis are among some of the more common infectious diseases of Asia likely to be affected.

Warmer and wetter weather will see areas previously uninhabitable for mosquitoes provide favourable breeding grounds, potentially leading to a geographical redistribution of diseases transmitted by mosquitoes. Theoretical modelling—which amalgamates predicted climate changes with the known climate suitability for *Anopheles*—suggests malaria-endemic regions will expand to cover larger geographical areas both north and south of the equator, including South China and Taiwan.[8] Conversely, the range of malaria may contract in areas of India and Southeast Asia, where temperatures will likely exceed 40°C and become unsuitable for *Anopheles* mosquitoes.[9]

Dengue, transmitted via *Aedes* mosqitoes, has seen a 30-fold incidence increase over the last 50 years globally, with an estimated 50 to 100 million annual cases worldwide and almost half the world's population living in countries

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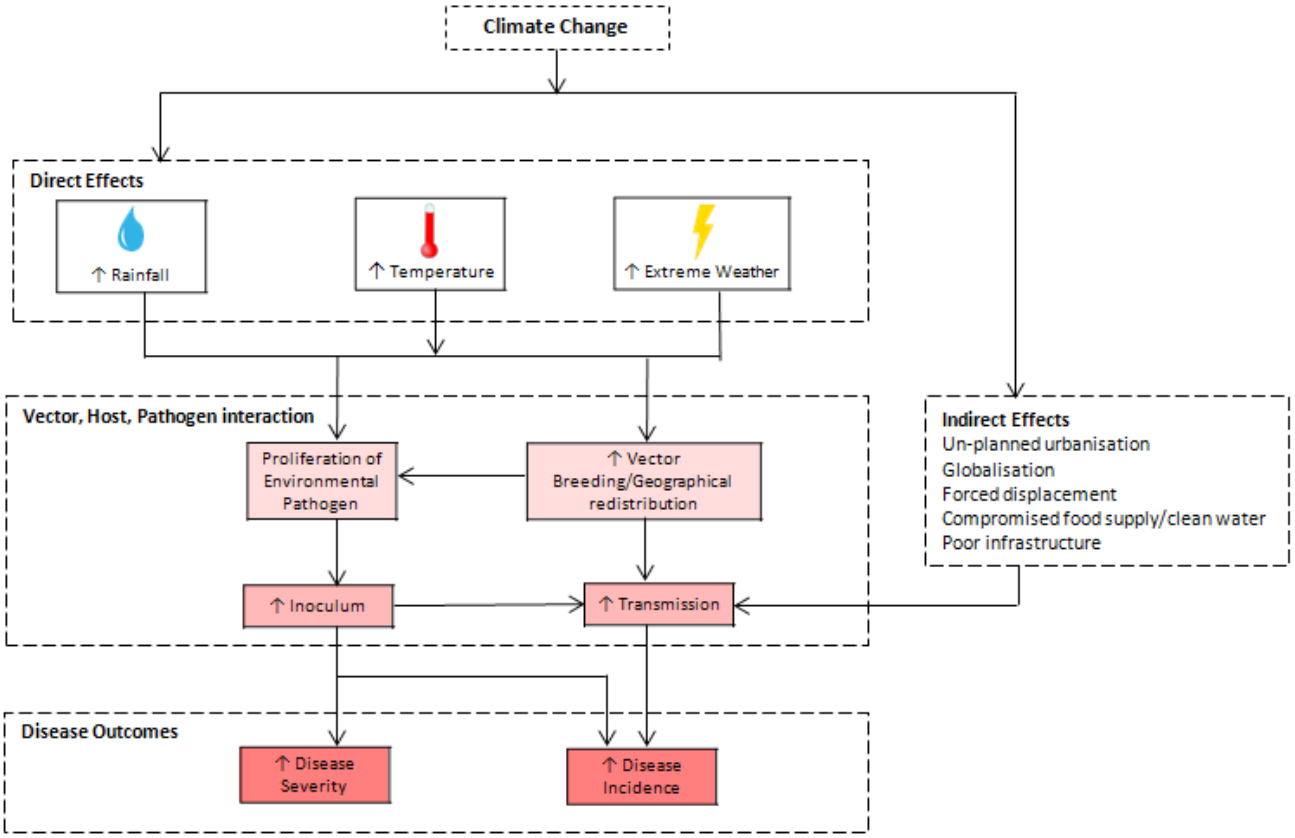

Fig. 1. Chart showing the potential direct and indirect consequences of climate change on the severity and incidence of infectious diseases.

where dengue is endemic.[10] In addition to the accelerated breeding and maturation cycle in warmer and more humid conditions, *Aedes* will proliferate faster as climate change coincides with increasing urbanisation; the increased density of human populations and abundant mosquito breeding sites, such as in household waste which encourages higher rates of infection. Singapore experienced an unprecedented dengue disease outbreak in 2005 with over 14,000 cases.[11] Kalimuddin et al[12] looked into the forecasting of dengue disease patterns in Singapore utilising mathematical modelling. The paper concluded that whilst the forecasting tool can predict future outbreaks, for it to be of any benefit, it requires coordinated local policymaking and international collaboration.

Water-borne Disease

Poor sanitation and shortages of clean drinking water increase the likelihood of waterborne disease outbreaks especially in countries with vulnerable infrastructure. With the expected increase in the frequency and intensity of precipitant-related weather events, flooding will occur more often. The subsequent increase in water runoff from surrounding areas may lead to cross-contamination of the water supply, especially if drainage is inadequate. Following heavy rainfall, a global systematic review by Cann et al[13] identified that *Vibrio* spp. and *Leptospira* spp. account for 45% of the pathogens found to infiltrate water supplies.

Moreover, higher temperatures are known to be associated with the amplification of enteric pathogens in the environment, including *Vibrio cholera*.[14] Higher inoculums of *V. cholerae* positively correlates with increased incidence of disease as well as more severe clinical manifestations.

Airborne and Droplet-Spread Disease

Environmental factors influence the transmission of airborne diseases—temperature and relative humidity both being important. Increasing urbanisation and globalisation facilitate human-to-human transmission, meaning the spread of disease will occur more readily, thereby increasing the chance of outbreaks.

The vast majority (95%) of all cases of tuberculosis (TB) occur in the tropics but a direct correlation to climate change is only speculative.[15] The estimated incidences of TB in the Philippines and Indonesia are 270 and 187 per 100,000 population, respectively.[16] More than half of all new cases of TB occur within Southeast Asia and the Western Pacific

regions;[16] these cases tend to occur within densely populated cities where ongoing rapid and unplanned urbanisation is common—a potentially indirect result of climate change.

Influenza viruses in temperate climates exhibit strong seasonal patterns, favouring winter epidemics. With this, one could theorise that cooler, less humid conditions are favourable to influenza and therefore forecasted climate changes may actually reduce the incidence of influenza. The tropics, however, experience significant influenza activity all-year round, with additional fluctuations correlating to neighbouring temperate seasonal changes.[17] The congregation of humans indoors may be an important factor to influenza epidemics, with adverse weather events being a driving factor.[18] It is conceivable that with increased rainfall and higher population densities, we may actually observe an increase in influenza across all climates.

Unlike seasonal influenza, human avian influenza virus outbreaks such as H5N1 and H7N9 occur sporadically and result from the direct interaction of humans with wild or domestic birds. Changing wild bird migration patterns and human proximity to infected birds will impact incidence rates. H7N9 infections have been strongly correlated with temperature and also with relative humidity of between 70% to 80%.[19]

A Prevalent Environmental, Climate-Sensitive Pathogen

Melioidosis, caused by the bacterium *Burkholderia pseudomallei* is endemic to Southeast Asia, Northern Australia and other tropical regions; it is estimated to cause 89,000 deaths per year worldwide.[20] Pneumonia is the most common clinical presentation but the variation in presentation and severity can make melioidosis difficult to diagnose, varying from acute fulminant sepsis to chronic non-specific symptoms. Rainfall and extreme weather events show a strong correlation with acute clinical infections.[21,22] *B. pseudomallei* is easily isolated from soil and surface water in endemic regions during these weather conditions. During heavy rainfall, the bacterium is aerosolised and inhaled. Moreover, heavy rainfall in the 14 days prior to presentation is independently associated with more severe illness and increased mortality. Climate change will likely have a profound impact on both the incidence of melioidosis in current endemic areas and its emergence in new areas.

Conclusion

Climate change will undoubtedly impact the geographical distribution of infectious diseases as well as affect incidence and in some cases, severity of disease. Expected effects of climate change on human health are largely negative and will be compounded by other social and human factors. Changes may be subtle and many may argue that human populations will adapt; however, failure to consider how these changes in infectious disease patterns will emerge and develop mitigating strategies is not acceptable. As always, neglect affects the most vulnerable populations disproportionately especially those with scarce resources and poor infrastructure, making combating the effects of climate change all the more challenging.

While this discussion focuses on infectious diseases, the direct impact of climate change on other health outcomes should not be overlooked. A World Health Organization (WHO) assessment concluded that climate change is estimated to cause 250,000 additional deaths per year between 2030 and 2050; 38,000 from the direct effects of heat-exposure in the elderly, and 95,000 due to childhood malnutrition.[23] Aero-allergen levels and pollution are increasing and will result in more cardiopulmonary illnesses including asthma. Furthermore, the psychological impact of extreme weather events and the associated stresses on individuals and communities are difficult to quantify. Arguably, mental health concerns relating to climate change may have the largest impact worldwide with devastating effects on human health.[24]

Public health decisions and necessary adaptive strategies require proactive implementation. Accurate forecasting and monitoring of climate change and its impact on infectious diseases is critical. Effective and robust forecasting can help influence government policies and social behaviours, which will be critical to combat some of the most important issues relating to climate change such as population displacement, increased urbanisation and poor sanitation. If direct associations between adverse weather events and communicable diseases can be established, we may be able to develop weather-based early warning systems to improve surveillance and predict the risk of outbreaks.

REFERENCES

1. Global Climate Change Week. Available at: http://globalclimatechangeweek.com/about/. Accessed on 18 July 2018.
2. Intergovernmental Panel on Climate Change. Climate Change 2011: Impacts, Adaptation, and Vulnerability. Geneva: IPCC Secretariat, Cambridge University Press; 2001.
3. Li X, Rowley RJ, Kostelnick JC, Braaten D, Meisel J. GIS analysis of global impacts from sea level rise. Photogramm Eng Remote Sens 2009;75:807-18.
4. Intergovernmental Panel on Climate Change. Climate Change 2007: Fourth Assessment Synthesis Report. Valencia, Spain: Cambridge University Press; 2007.
5. National Climate Change Secretariat. Impact of Climate Change on Singapore. Available at: https://www.nccs.gov.sg/climate-change-and-singapore/national-circumstances/impact-of-climate-change-on-singapore. Accessed on 18 July 2018.

6. Amato R, Hein D. Southeast Asia Climate Analysis and Modelling Framework. United Kingdom: Met Office; 2014. Available at: https://www.metoffice.gov.uk/binaries/content/assets/mohippo/pdf/n/i/southeast_asia_climate_framework.pdf. Accessed on 18 July 2018.
7. Case M, Ardiansyah F, Spector E. Climate Change in Indonesia: Implications for Humans and Nature. Available at: http://www.worldwildlife.org/climate/Publications/WWFBinaryitem7664.pdf. Accessed on 18 July 2018.
8. Khormi HM, Kumar L. Future malaria spatial pattern based on the potential global warming impact in South and Southeast Asia. Geospatial Health 2016;11:290-8.
9. Dhiman RC, Sharmila P, Dash AP. Climate change and malaria in India: interplay between temperatures and mosquitoes. Regional Health Forum 2008;12:27-31.
10. World Health Organization. Global Strategy for Dengue Prevention and Control, 2012-2020. WHO Report. Available at: http://www.who.int/iris/handle/10665/75303. Accessed on 18 July 2018.
11. Koh BK, Ng LC, Kita Y, Tang CS, Ang LW, Wong KY, et al. The 2005 dengue epidemic in Singapore: epidemiology, prevention and control. Ann Acad Med Singapore 2008;37:538-45.
12. Kalimuddin S, Low JGH, Ooi EE. Dengue disease modelling and forecasting: utility and limitations. Ann Acad Med Singapore 2016;45:121-2.
13. Cann KF, Thomas DR, Salmon RL, Wyn-Jones AP, Kay D. Extreme water-related weather events and waterborne disease. Epidemiol Infect 2013;141:671-86.
14. Lipp EK, Huq A, Colwell RR. Effects of global climate on infectious disease: the cholera model. Clin Microbiol Rev 2002;15:757-70.
15. Grange JM, Zumla AI. Tuberculosis. In: Cook GC, Alimuddin IZ, editors. Manson's Tropical Diseases. Saunders Elsevier; 2009. p. 983-1038.
16. World Health Organization. Global Tuberculosis Report, 2012. Available at: http://www.who.int/tb/publications/global_report/gtbr12_main.pdf. Accessed on 18 July 2018.
17. Saha S, Chadha M, Al Mamun A, Rahman M, Sturm-Ramirez K, Chittaganpitch M, et al. Influenza seasonality and vaccination timing in tropical and subtropical areas of southern and south-eastern Asia. Bull World Health Organ 2014;92:318-30.
18. Tamerius J, Nelson MI, Zhou SZ, Viboud C, Miller MA, Alonso WJ. Global influenza seasonality: reconciling patterns across temperate and tropical regions. Environ Health Perspect 2011;119:439-45.
19. Li J, Rao Y, Sun Q, Wu X, Jin J, Bi Y, et al. Identification of climate factors related to human infection with avian influenza A H7N9 and H5N1 viruses in China. Nature Sci Rep 2015;5:18094.
20. Wiersinga WJ, Virk HS, Torres AG, Currie BJ, Peacock SJ, Dance DAB, Limmathurotsakul D. Melioidosis. Nat Rev Dis Primers 2018;4:17107.
21. Currie BJ, Fisher DA, Howard DM, Burrow JN, Lo D, Selva- Nayagam S, et al. Endemic melioidosis in tropical northern Australia: a 10-year prospective study and review of the literature. Clin Infect Dis 2000;31:981-6.
22. Currie BJ, Jacups SP. Intensity of rainfall and severity of melioidosis, Australia. Emerg Infect Dis 2003;9:1538-42.
23. World Health Organization. Climate Change and Health. Available at: http://www.who.int/en/news-room/fact-sheets/detail/climate-change-and-health. Accessed on 18 July 2018.
24. Portier CJ, Thigpen Tart K, Carter SR, Dilworth CH, Grambsch AE, Gohlke, J, et al. (2010). A Human Health Perspective On Climate Change: A Report Outlining the Research Needs on the Human Health Effects of Climate Change. Research Triangle Park, NC: Environmental Health Perspectives/National Institute of Environmental Health Sciences; 2010. Available at: https://www.niehs.nih.gov/health/materials/a_human_health_perspective_on_climate_change_full_report_508.pdf. Accessed on 18 July 2018.

Original Article

Antenatal Anxiety: Prevalence and Patterns in a Routine Obstetric Population

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Abstract

Introduction: Expectant mothers may appear anxious even during healthy pregnancies. Unfortunately, little is known about antenatal anxiety, and affected women may remain undetected and untreated. This study aimed to examine the prevalence, incidence, course and associations of high state anxiety in routine obstetric care. Materials and Methods: This was an observational prospective cohort study at a large maternity unit. Obstetric outpatients with low-risk singleton pregnancies were recruited during first trimester consultations. Participants provided sociodemographic data and completed the State-Trait Anxiety Inventory (STAI) and Edinburgh Postnatal Depression Scale. The STAI was re-administered at each subsequent trimester. Results: Prevalence and incidence of high state anxiety among 634 completers were 29.5% (95% CI 25.6%-33.6%) and 13.9% (95% CI 9.9%-18.0%), respectively. Anxiety was persistent in 17.0% (95% CI 14.3%-20.2%) and transient in 26.3% (95% CI 23.1%-29.9%). Only persistently anxious participants had high mean second trimester state anxiety scores. Odds for anxiety of greater persistence increased by 29% (95% CI 24%-35%) per 1-point increase in first trimester depression scores, and decreased by 36% (95% CI 7%-56%) with tertiary education. Conclusion: Antenatal anxiety symptoms are common even in normal pregnancies, especially among women with depression and lower education. Our study indicates value in exploring diagnostic criteria and quantitative measures for antenatal anxiety.

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Key words: Depression, Pregnancy, State-Trait Anxiety Inventory

Introduction

Background

Anxiety disorders represent the pathological variant of a common human emotion, and are thought to evolve from childhood adversity leading to chronically increased stress reactivity.[1] A local study found that women are more than 3 times as likely as men to experience a generalised anxiety disorder.[2] During pregnancy, women may become even more anxiety-prone, which makes it difficult to identify pathological states.[3] It may be that the female's propensity to anxiety becomes exacerbated by pregnancy hormones.[4-6] Another challenge with antenatal anxiety is that it often presents with elements of obsessive-compulsive disorder, generalised anxiety disorder or panic disorder, while falling short of meeting criteria for a specific diagnosis.[7] It may also overlap with depressive symptoms.[8]

Despite these issues, antenatal anxiety has been described as "a distinct and definable syndrome…closely associated with state anxiety…tied specifically to concerns about a current pregnancy".[9] These concerns are typically about maternal and fetal health, the birthing experience and the parenting role.[9,10] Antenatal anxiety consistently occurs more

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commonly than antenatal depression and postnatal anxiety.[10,11] It predisposes toward pre-eclampsia and postnatal mood disorders in affected mothers, and emotional and attention dysregulation in their children.[12-15] It also shows biological correlations with maternal hormones and inflammatory markers, and with neonatal brain morphology.[16-18]

However, a lack of formal clinical criteria and rating scales for antenatal anxiety impedes diagnosis and screening. Existing research is based on varying definitions and measurements. Known prevalence rates range widely from 11% to 60%.[7,11] With this level of uncertainty about antenatal anxiety, affected women may remain undetected, as obstetric care providers may not be fully aware of the potential burden of illness, and psychiatric care providers may not be fully equipped to recognise or manage this condition. The 2017 Confidential Enquiry into Maternal Deaths and Morbidity cited maternal suicide as the third largest cause of direct maternal deaths between 2013 and 2015 in the United Kingdom, and estimated that better care might have prevented this outcome in 26% of women with severe mental illness.[19] This indicates the importance of clinical awareness of common mental conditions during the perinatal period.

Objectives

We designed this study on antenatal state anxiety in a large group of women with low-risk pregnancies receiving regular routine obstetric care. Our primary aim was to: a) determine the prevalence and incidence of high antenatal state anxiety; and b) describe its course as pregnancy progresses, based on sequential measurements of state anxiety scores. Our secondary aim was to: c) examine the associations among antenatal state anxiety, first-trimester depressive symptoms and participants' sociodemographic characteristics.

Materials and Methods

Study Design and Setting

This observational prospective cohort study took place between July 2012 and April 2014. Participants with low-risk singleton pregnancies were systematically surveyed at each trimester, specifically at 11 to 14 weeks, 18 to 22 weeks and 28 to 32 weeks of gestation. The study protocol was approved by the Institutional Review Board (CIRB Ref 2010/214/D) and written informed consent was obtained from every participant. Refusal of, and withdrawal from, participation in this study did not impact the obstetric care provided to patients.

Participants

Participants comprised obstetric female outpatients under 14 weeks' gestation at recruitment, receiving routine antenatal care for singleton pregnancies deemed at low risk of miscarriage. Women with multiple pregnancies, serious chronic medical conditions (such as autoimmune disorders and renal disease), and/or current/previous pregnancies complicated by chromosomal anomalies or cervical incompetence, were excluded from the study.

Variables and Data Sources

During their initial first trimester assessment at 11 to 14 gestational weeks, participants were asked by trained clinical research coordinators to provide basic demographic data, including age, race, education level and antenatal lifestyle habits. Previous studies have indicated that antenatal anxiety may be more common in the presence of maternal factors such as younger age, minority race, lower education, non-employment, smoking and drinking.[20,21] Participants also completed psychometric measures for anxiety and depression. The anxiety measure was re-administered during the second and third trimesters, so that participants had state anxiety scores for every trimester. Participants with high scores were advised about seeking psychiatric care, which was available in the same institution.

Spielberger State-Trait Anxiety Inventory (STAI)

The STAI has been validated in antenatal populations and is recommended as a research screening tool for general anxiety.[22] It consists of 40 self-administered items, each rated on a 4-point scale ranging from 1 to 4, with higher scores indicating greater severity. The first 20 items assess the respondent's current state anxiety (i.e. STAI-State subscale), while the latter 20 items assess the respondent's general predisposition to anxiety (i.e. STAI-Trait subscale). The STAI-State subscale was our primary outcome measure for high antenatal state anxiety. These scores are generally interpreted based on cutoff scores for population-specific normative data, which are unfortunately lacking in the local setting. However, a 2013 Singaporean study found a cutoff score of 43 to yield 84% sensitivity and 59% specificity in identifying clinical antenatal anxiety.[23] We therefore used this cutoff score to define high state anxiety. The STAI-Trait subscale was not used in this study because it may be unstable during the perinatal period, with low test-retest reliability.[3]

Repeated measures are recommended during pregnancy because 50% of positive scores for emotional distress resolve within a fortnight.[24] To differentiate clinically significant symptoms from transient distress, we defined 'persistent anxiety' as STAI-State scores of 43 or more in at least 2 consecutive trimesters. Participants with STAI-State scores of 43 or more in either 1 or 2 non-consecutive trimesters were defined as having 'transient anxiety', while those who scored 42 or less in all trimesters were defined as 'non-anxious'. We believe these definitions to be more

stringent and clinically meaningful than simply performing a single assessment for the entire pregnancy.

Edinburgh Postnatal Depression Scale (EPDS)

The EPDS is also a self-administered screening questionnaire. It consists of 10 items, each rated on a 4-point scale ranging from 0 to 3, with higher scores indicating greater severity. Although it was developed as a screening tool for postnatal depression, it has also been used to screen for antenatal major depression using a cutoff score of 15 or more.[25]

Missing Data

Questionnaires were checked for completion by the clinical research coordinators during each assessment. The completers answered over 99.5% of all questions in the STAI and EPDS. Blanks were filled using individual mean imputation, which is a valid method of handling small proportions of missing data from ordinally-scaled instruments.[26]

Bias

As both the STAI and EPDS are screening instruments, our results may overestimate the prevalence of true clinical disorders.

Study Size

This study represented a secondary analysis of a main study to prospectively examine adverse physical and psychological obstetric outcomes, in which 3271 patients were non-selectively approached. Among these, 451 patients were ineligible due to non-viable pregnancies, uterine malformations, communication problems and gestational age above 14 weeks. Among the 2820 eligible patients, 909 patients agreed to participate and had delivered by the end of the study period.

Statistical Methods

All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS, IBM Statistics) software version 19.0. Calculations of period-specific prevalence and incidence of antenatal anxiety were based on the proportion of participants scoring 43 or more on the STAI-State subscale in each trimester. The 95% confidence intervals (CIs) of these proportions were estimated using the Wilson-score method.

The course of antenatal anxiety was defined by the proportions of participants in each of the 3 anxiety subgroups (i.e. 'non-anxious', 'transiently anxious' and 'persistently anxious', as described under STAI section).

The simultaneous 95% CIs of these multinomial proportions were estimated using the Sison-Glaz method.[27] Mean STAI-State scores, with standard deviations (SD), of each anxiety subgroup at each trimester were plotted to graphically present changes over the course of pregnancy.

To examine associations among antenatal state anxiety, sociodemographic factors and first trimester depressive symptoms, we performed an ordinal logistic regression using 'non-anxious', 'transiently anxious' and 'persistently anxious' statuses as response variables, with the 'non-anxious' subgroup as the reference class. We entered all prespecified sociodemographic factors and first trimester EPDS scores as independent variables into the regression model. Variables with regression coefficients statistically significant at the 5% level of significance were considered associated with anxiety subgroup status. Associations were quantified using adjusted odds ratios (ORs) and their corresponding 95% CIs.

To assess the impact of attrition, we examined differences in sociodemographic and baseline clinical characteristics between participants who completed versus those who did not complete the study, by comparing distributions using the chi-squared test for categorical variables and the 1-way analysis of variance (ANOVA) test for interval-scaled variables.

Results

Participants

Among 909 participants, 69.7% completed assessments in all 3 trimesters ('completers'). The remaining 30.3% of the sample were considered to be 'non-completers'.

Descriptive Data

The 909 participants were aged 17 to 45 years (mean 30 years, SD 5 years) and the racial distribution was 48.5% Chinese, 29.5% Malay, 11.9% Indian and 9.9% other races. For comparison, the national ethnic mix in 2015 was 76.2% Chinese, 15.0% Malay, 7.4% Indian and 1.4% other races.[28] In addition, 91.7% of our participants were married, 63.8% had at least tertiary education and 78.0% were employed.

Table 1 summarises the demographic characteristics of the 909 participants, with comparisons: a) among the 3 anxiety subgroups; and b) between completers and non-completers. Among the 3 anxiety subgroups, univariate analyses reveal differences in age, marital status, educational level and smoking habits. The only difference between the completers and non-completers was that the latter were more likely to belong to minority ethnic groups (OR 1.511, 95% CI 1.085-2.106, $P = 0.014$).

Prevalence and Incidence of High State Anxiety

Table 2 shows the prevalence and incidence of high state anxiety in the 634 completers. Among the 187 who were anxious during the first trimester (i.e. with prevalent state anxiety), one-third were anxious throughout pregnancy, while half were no longer anxious by the third trimester,

Table 1. Participants' Demographics with Comparisons: (A) among Anxiety Subgroups; and (B) between Completers and Non-Completers

	(A) Completers (n = 634)				(B) All Participants (n = 909)		
	Persistent Anxiety	**Transient Anxiety**	**No Anxiety**	***P* Value**	**Completers**	**Non-Completers**	***P* Value**
n (%)	108 (17.0)	167 (26.3)	359 (56.6)	-	634 (69.7)	275 (30.3)	-
Age range, y	17 – 44	18 – 42	19 – 44	-	17 – 44	17 – 45	-
Mean, y ± SD	29 ± 5	30 ± 5	31 ± 5	0.019*	30 ± 5	31 ± 5	0.477
Race, n (%)							
Chinese	48 (44.4)	87 (52.1)	195 (54.3)	0.612	330 (52.1)	111 (40.7)	0.011*
Malay	37 (34.3)	45 (26.9)	97 (27.0)	0.612	179 (28.2)	89 (32.6)	0.011*
Indian	14 (13.0)	18 (10.8)	34 (9.5)	0.612	66 (10.4)	42 (15.4)	0.011*
Others	9 (8.3)	17 (10.2)	33 (9.2)	0.612	59 (9.3)	31 (11.4)	0.011*
Marital status, n (%)							
Married	92 (85.2)	156 (93.4)	330 (91.9)	0.047*	578 (91.2)	256 (93.8)	0.186
Unmarried		11 (6.6)	29 (8.1)	0.047*	56 (8.8)	17 (6.2)	0.186
Education, n (%)							
Non-tertiary	62 (57.4)	63 (37.7)	110 (30.6)	<0.001†	235 (37.1)	94 (34.2)	0.406
Tertiary	46 (42.6)	104 (62.3)	249 (69.4)	<0.001†	399 (62.9)	181 (65.8)	0.406
Employment status, n (%)							
Employed	80 (74.1)	133 (79.6)	290 (80.8)	0.318	503 (79.3)	206 (75.5)	0.194
Not employed	28 (25.9)	34 (20.4)	69 (19.2)	0.318	131 (20.7)	67 (24.5)	0.194
Housing type, n (%)							
Public	104 (96.3)	159 (95.2)	328 (91.4)	0.099	591 (93.2)	255 (93.4)	0.917
Private	4 (3.7)	8 (4.8)	31 (8.6)	0.099	43 (6.8)	18 (6.6)	0.917
Antenatal smoking, n (%)							
Smoking	8 (7.4)	3 (1.8)	4 (1.1)	0.001*	15 (2.4)	12 (4.4)	0.099
No smoking	100 (92.6)	164 (98.2)	355 (98.9)	0.001*	619 (97.6)	261 (95.6)	0.099
Antenatal alcohol use, n (%)							
Drinking	2 (1.9)	1 (0.6)	6 (1.7)	0.574	9 (1.4)	3 (1.1)	0.698
No drinking	106 (98.1)	166 (99.4)	353 (98.3)	0.574	625 (98.6)	270 (98.9)	0.698
Antenatal recreational drug use, n (%)							
Drug use	0 (0)	0 (0)	0 (0)	NA	0 (0)	0 (0)	NA
No drug use	108 (100)	167 (100)	359 (100)	NA	634 (100)	273 (100)	NA
Antenatal coffee consumption, n (%)							
Coffee	24 (22.2)	33 (19.8)	78 (21.7)	0.848	135 (21.3)	52 (19.0)	0.443
No coffee	84 (77.8)	134 (80.2)	281 (78.3)	0.848	499 (78.7)	221 (81.0)	0.443
Antenatal regular exercise, n (%)							
Exercise	4 (3.7)	12 (7.2)	24 (6.7)	0.462	40 (6.3)	13 (4.8)	0.362
No exercise	104 (96.3)	155 (92.8)	335 (93.3)	0.462	594 (93.7)	260 (95.2)	0.362
Antenatal dietary supplement use, n (%)							
Supplements	98 (90.7)	155 (92.8)	326 (90.8)	0.728	579 (91.3)	250 (91.6)	0.902
No supplements	10 (9.3)	12 (7.2)	33 (9.2)	0.728	55 (8.7)	23 (8.4)	0.902

NA: Not applicable
*Significant at $P < 0.05$.
†Significant at $P < 0.001$.
Percentages apply to column data. Missing data were excluded from the analysis.

Table 2. Prevalence and Incidence of Anxiety among Study Completers (n = 634)

Anxiety Typology	Description	Trimester*			n	%	95% CI
		1st	2nd	3rd			
Never anxious	-	0	0	0	359	56.6	52.7 – 60.7
Prevalent anxiety							
	Anxious at 1st trimester				187	29.5	25.6 – 33.6
	Resolved at 2nd trimester	1	0	0	74	36.6†	32.1 – 47.1
	Resolved at 2nd but recurred at 3rd trimester	1	0	1	23	12.3†	4.8 – 19.8
	Resolves at 3rd trimester	1	1	0	26	13.9†	6.4 – 21.4
	Anxious at all trimesters	1	1	1	64	34.2†	26.7 – 41.8
Incident anxiety							
	Developed anxiety after 1st trimester				88	13.9	9.9 – 18.0
	Incident at 2nd and persisted at 3rd trimester	0	1	1	18	20.4‡	10.2 – 31.7
	Incident at 2nd and resolved at 3rd trimester	0	1	0	25	28.4‡	18.2 – 39.7
	Incident at 3rd trimester	0	0	1	45	51.1‡	40.9 – 62.4

CI: Confidence interval
*0 = not anxious (STAI-State score <43), 1 = anxious (STAI-State score ≥43).
†Total n = 187, 95% CI computed using Sison-Graz method for multinomial proportions with 4 categories.
‡Total n = 88, 95% CI computed using Sison-Graz method for multinomial proportions with 3 categories.

and the remainder had anxiety that resolved in the second trimester but recurred in the third. Among the 88 completers who developed anxiety after the first trimester (i.e. with incident state anxiety), half did so during the second trimester, of which half continued being anxious in the third trimester. In total, 23.7% (95% CI 20.5%-27.1%) of all completers were anxious during the third trimester.

Course of High Antenatal State Anxiety

Among the 634 completers, 17.0% (95% CI 14.3%-20.2%) were persistently anxious. Transient anxiety affected 26.3% (95% CI 23.1%-29.9%) while 56.6% (95% CI 52.7%-60.4%) were not anxious. As expected, the persistently anxious subgroup had the highest overall mean STAI-State score of 47.8 (95% CI 46.9-48.7), while the transiently anxious subgroup averaged 39.1 (95% CI 38.4-39.7) and the non-anxious subgroup 29.8 (95% CI 29.3-30.3).

Figure 1 shows the progression of STAI-State scores by trimester of the 634 completers. The persistently anxious subgroup was unique in scoring higher in the second than in the third trimester (49.1 [SD 4.8] vs 47.5 [SD 7.4], P = 0.031). Within this subgroup, 75.9% (95% CI 67.1%-83.1%) remained anxious in the third trimester. Among the transiently anxious subgroup, 40.7% (95% CI 33.6%-48.3%) were anxious in the third trimester.

Associations with Demographic Characteristics and First Trimester Depressive Symptoms

The completers' first-trimester EPDS scores ranged from 0 to 26, with mean 8.0 (SD 4.9). Their demographic characteristics (except drug use, as it was reported by none) and first trimester EPDS scores were included as variables in our ordinal logistic regression model, the detailed results of which are presented in Table 3. Each 1-point increase in first trimester EPDS score was associated with an increment of 29% (95% CI 24%-35%) in the odds of being in a more persistent state of anxiety, while having a tertiary education was associated with a reduction of 36% (95% CI 7%-56%) in the same.

Discussion

Key Results and Interpretation

High antenatal state anxiety was common, occurring in nearly half of our participants. Most of the anxious participants were already anxious by the first trimester. However, most of them were no longer anxious by the third

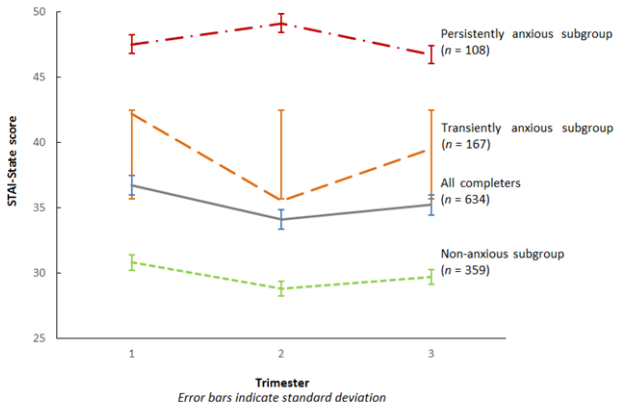

Fig. 1. Graph showing the mean STAI-State scores at each trimester. STAI: State-Trait Anxiety Inventory.

Table 3. Analysis by Ordinal Logistic Regression of Variables Associated with Antenatal Anxiety Subgroup

Variable	Estimate	Standard Error	*P* Value	Adjusted OR	95% CI
Age	-0.002	0.018	0.905	1.00	0.96 – 1.03
EPDS score	0.257	0.021	<0.001*	1.29	1.24 – 1.35
Race					
Chinese	-0.028	0.314	0.930	0.97	0.53 – 1.80
Malay	-0.311	0.337	0.356	0.73	0.38 – 1.42
Indian	0.012	0.386	0.976	1.01	0.48 – 2.15
Others	0.000			1.00	
Marital status					
Married	0.081	0.315	0.796	1.08	0.58 – 2.01
Not married	0.000			1.00	
Education					
Tertiary	-0.450	0.190	0.018†	0.64	0.44 – 0.93
Non-tertiary	0.000			1.00	
Employment status					
Employed	0.082	0.219	0.709	1.09	0.71 – 1.67
Not employed	0.000			1.00	
Housing type					
Private	-0.484	0.376	0.198	0.62	0.29 – 1.29
Public	0.000			1.00	
Antenatal smoking					
No smoking	-1.038	0.578	0.073	0.35	0.11 – 1.10
Smoking	0.000			1.00	
Antenatal alcohol use					
No drinking	0.615	0.837	0.463	1.85	0.36 – 9.53
Drinking	0.000			1.00	
Antenatal coffee consumption					
No coffee	-0.098	0.215	0.649	0.91	0.60 – 1.38
Coffee	0.000			1.00	
Antenatal regular exercise					
Exercise	0.161	0.356	0.651	1.17	0.58 – 2.36
No exercise	0.000			1.00	
Antenatal dietary supplement use					
Supplements	0.155	0.307	0.614	1.17	0.64 – 2.13
No supplements	0.000			1.00	

CI: Confidence interval; EPDS: Edinburgh Postnatal Depression Scale; OR: Odds ratio
*Significant at $P < 0.001$.
†Significant at $P < 0.05$.

trimester, likely indicating transient emotional distress caused by common pregnancy-related stressors. Even in normal pregnancies, the first trimester is often a period of uncertainty because most miscarriages and investigations for fetal anomalies happen during this time, while the third trimester is often a period of anticipation and physical discomfort.

Persistent state anxiety, which is more likely to be clinically significant, was observed in 17.0% of our participants. In comparison, a previous Singaporean study diagnosed anxiety disorders in 12.5% of high-risk pregnancies.[23] We postulate that our figure is higher due to our use of a screening scale, necessitated by our larger study size; also, we assessed for state anxiety instead of disorder-specific diagnostic criteria. A Hong Kong study

that measured antenatal anxiety on a scale that was also not disorder-specific found that 17.8% of its participants were anxious during all 3 trimesters.[21]

Persistently anxious participants were unique in having high STAI-State scores in the second trimester, which is usually a period of relative obstetric and emotional stability.[29] We believe this finding of high second trimester state anxiety to be novel, elicited through our approach of repeated assessments and stratification by anxiety subgroup. If supported by subsequent research, it may identify the second trimester as an optimal time to screen pregnant women for clinically significant anxiety, enabling early and appropriate referrals for psychiatric care.

Compared with any demographic characteristic, first trimester EPDS scores showed the strongest association with high state anxiety. The overlap between depression and anxiety in the general population has been recognised for decades and is thought to be due to genetic, biological and neurodevelopmental similarities in the 2 conditions.[30,31] Our results suggest that this overlap also exists in pregnant women, with the clinical implication that women who present with ostensibly 1 of these disorders should be assessed for the other.

The only demographic characteristic significantly associated with antenatal anxiety was lack of tertiary education. Higher education is linked with higher employment rates and income, and highly educated people tend to enjoy better health and are more likely than their counterparts to seek medical treatment early when ill.[32,33] Given the high value placed on education and achievement in Singapore, and that nearly two-thirds of our participants had a tertiary education, it is probable that the less educated minority lacked advantages and means that may have protected against anxiety.

Limitations and Generalisability

One main limitation was difficulty in defining and measuring antenatal anxiety. Existing studies have taken different approaches to this condition, and STAI scores may be interpreted variously, based on cutoff scores for population-specific normative data, which may differ among countries. Our novel method of sequentially administrating and interpreting the STAI has not been validated for diagnostic and prognostic accuracy. Nonetheless, our cutoff was supported by existing local data.[23]

Second, the unknown anxiety status of the non-completers may have led to inaccuracies in our prevalence estimations. However, existing studies suggest that dropouts tend to be depressed rather than anxious. Hence, we may not have underestimated the prevalence and incidence of anxiety.[34,35] Third, the data we obtained were participant-reported and may have been affected by reporting heterogeneity among individuals. Fourth, our study was not powered to detect the effects of all included sociodemographic variables such as smoking, which occurred in a distinct minority. Also, the direction of causality between anxiety and lifestyle practices could not be ascertained.

The generalisability of our results may be limited by participation and attrition biases. The racial distribution in our study differed from that of the country in general as we had a smaller proportion of Chinese participants. The completers made regular attendances, which implies that they were invested in this model of obstetric care and open to psychometric assessment, while the non-completers differed in race and may have had different values and practices that could have impacted their mental health in ways unknown to us.

Conclusion

Despite its limitations, our study has clear strengths. It is one of the largest prevalence studies of antenatal anxiety in an Asian population, and is one of the rare few to conduct assessments at every trimester, instead of just once during the entire pregnancy. This provided a temporal element with which to differentiate persistent from transient anxiety, the former being more likely to be clinically significant. Finally, we recruited non-selected participants with normal pregnancies, most of whom completed all assessments, thereby yielding results that may be useful as baseline information for clinical and research purposes.

In summary, we found antenatal anxiety symptoms to be common in routine obstetric practice, with 1 in 6 participants experiencing them persistently. A novel finding was that these participants remained anxious even during the second trimester, which is typically a period of relative physical and emotional stability. First trimester depression and lack of tertiary education were identified as factors significantly associated with antenatal anxiety. Our findings indicate value in developing diagnostic criteria and quantitative measures for antenatal anxiety, so that affected women may be detected and treated appropriately.

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REFERENCES

1. Heim C, Nemeroff CB. The impact of early adverse experiences on brain systems involved in the pathophysiology of anxiety and affective disorders. Biol Psychiat 1999;46:1509-22.
2. 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.
3. Hundley V, Gurney E, Graham W, Rennie AM. Can anxiety in pregnant women be measured using the State-Trait Anxiety Inventory. Midwifery 1998;14:118-21.
4. McLean CP, Asnaani A, Litz BT, Hofmann SG. Gender differences in anxiety disorders: prevalence, course of illness, comorbidity and burden of illness. J Psychiat Res 2011;45:1027-35.
5. Pigott TA. Gender differences in the epidemiology and treatment of anxiety disorders. J Clin Psychiatry 1999;60 Suppl 18:4-15.
6. Levine RE, Oandasan AP, Primeau LA, Berenson AB. Anxiety disorders during pregnancy and postpartum. Amer J Perinatol 2003;20:239-48.
7. Andersson L, Sundstrom-Poromaa I, Wulff M, Astrom M, Bixo M. Depression and anxiety during pregnancy and six months postpartum: a follow-up study. Acta Obstetricia et Gynecologica 2006;85:937-44.
8. Ross L, Evans SG, Sellers E, Romach M. Measurement issues in postpartum depression part 1: anxiety as a feature of postpartum depression. Arch Women Ment Hlth 2003;6:51-7.
9. Schetter CD, Tanner L. Anxiety, depression and stress in pregnancy: implications for mothers, children, research and practice. Curr Opin Psychiatry 2012;25:141-8.
10. Henderson J, Redshaw M. Anxiety in the perinatal period: antenatal and postnatal influences and women's experience of care. J Reprod Infant Psyc 2013;31:465-78.
11. Faisal-Cury A, Menezes PR. Prevalence of anxiety and depression during pregnancy in a private setting sample. Arch Womens Ment Health 2007;10:25-32.
12. Kurki T, Hiilesmaa V, Raitasalo R, Mattila H, Ylikorkala O. Depression and anxiety in early pregnancy and risk for preeclampsia. Obstet Gynecol 2000;95:487-90.
13. Grant KA, McMahon C, Austin MP. Maternal anxiety during the transition to parenthood: a prospective study. J Affect Disord 2008;108:101-11.
14. Chong SC, Broekman BF, Qiu A, Aris IM, Chan YH, Rifkin-Graboi A, et al. Anxiety and depression during pregnancy and temperament in early infancy: findings from a multi-ethnic, Asian prospective birth cohort study. Infant Ment Health J 2016;37:584-98.
15. Barker E, Jaffee S, Uher R, Maughan B. The contribution of prenatal and postnatal maternal anxiety and depression to child maladjustment. Depress Anxiety 2011;28:696-702.
16. Coussons-Read M, Lobel M, Carey C, Kreither M, D'Anna K, Argys L, et al. The occurrence of preterm delivery is linked to pregnancy-specific distress and elevated inflammatory markers across gestation. Brain Behav Immun 2012;26:650-9.
17. Rebelo F, de Jesus Pereira Pinto T, Franco-Sena AB, Lepsch J, Benaim C, Struchiner CJ, et al. Plasma adiponectin is inversely associated with antenatal anxiety: results from a Brazilian cohort. Psychoneuroendocrinology 2015;51:92-100.
18. Qiu A, Tuan TA, Ong ML, Li Y, Chen H, Rifkin-Graboi A, et al. COMT haplotypes modulate associations of antenatal maternal anxiety and neonatal cortical morphology. Am J Psychiatr 2015;172:163-72.
19. MBRRACE-UK. Saving Lives, Improving Mothers' Care – Lessons Learned to Inform Maternity Care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity, 2013-15. Oxford: National Perinatal Epidemiology Unit, University of Oxford; 2017.
20. Biaggi A, Conroy S, Pawlby S, Pariante CM. Identifying the women at risk of antenatal anxiety and depression: a systematic review. J Affect Disord 2016;191:62-77.
21. Lee AM, Lam SK, Lau SMSM, Chong CSY, Chui HW, Fong DYT. Prevalence, course, and risk factors for antenatal anxiety and dep\ression. Obstet Gynecol 2007;110:1102-12.
22. Meades R, Ayers S. Anxiety measures validated in perinatal populations: a systematic review. J Affect Disord 2011;133:1-15.
23. Thiagayson P, Krishnaswamy G, Lim M, Sung SC, Haley C, Fung D, et al. Depression and anxiety in Singaporean high-risk pregnancies – prevalence and screening. Gen Hosp Psychiatry 2013;35:112-6.
24. Matthey S, Ross-Hamid C. Repeat testing on the Edinburgh Depression Scale and the HADS-A in pregnancy: diferentiating between transient and enduring distress. J Affect Disord 2012;141:213-21.
25. Gibson J, McKenzie-McHarg K, Shakespeare J, Price J, Gray R. A systematic review of studies validating the Edinburgh Postnatal Depression Scale in antepartum and postpartum women. Acta Psychiatr Scand 2009;119:350-64.
26. Shrive FM, Stuart H, Quan H, Ghali WA. Dealing with missing data in a multi-question depression scale: a comparison of imputation methods. BMC Med Res Methodol 2006;6:57.
27. Sison CP, Glaz J. Simultaneous confidence intervals and sample size determination for multinomial proportions. JASA 1995;90:366-9.
28. NPTD. Population in brief. Singapore: National Population & Talent Division, Prime Minister's Office, Singapore Department of Statistics, Ministry of Home Affairs, Immigration & Checkpoints Authority; 2015. Available at: https://www.strategygroup.gov.sg/docs/default-source/Population/population-in-brief-2015.pdf. Accessed on 1 March 2018.
29. Teixeira C, Fiqueiredo B, Conde A, Pacheco A, Costa R. Anxiety and depression during pregnancy in women and men. J Affect Disord 2009;119:142-8.
30. Gorman JM. Comorbid depression and anxiety spectrum disorders. Depress Anxiety 1996;4:160-8.
31. Watson D. Rethinking the mood and anxiety disorders: a quantitative hierarchical model for DSM-V. J Abnorm Psychol 2005;114:522.
32. Baum S, Ma J, Payea K. Education pays 2013 – the benefits of higher education for individuals and society. Available at: https://trends.collegeboard.org/sites/default/files/education-pays-2013-full-report.pdf. Accessed on 1 March 2018.
33. Levin H, Belfield C, Muennig P, Rouse C. The costs and benefits of an excellent education for all of America's children. Teachers College, Columbia University; 2006.
34. DiMatteo MR, Lepper HS, Croghan TW. Depression is a risk factor for noncompliance with medical treatment: meta-analysis of the effects of anxiety and depression on patient adherence. Arch Intern Med 2000;160:2101-7.
35. Issakidis C, Andrews G. Pretreatment attrition and dropout in an outpatient clinic for anxiety disorders. Acta Psychiatr Scand 2004;109:426-33.

Original Article

Five-Year Review of Patients Presenting with Non-Accidental Injury to a Children's Emergency Unit in Singapore

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Abstract

Introduction: There is an increasing trend of physical child abuse cases reported in Singapore. Children presenting to the Emergency Department with injuries require a high index of suspicion for clinicians to distinguish those that are abusive in nature. Materials and Methods: A retrospective study of children with diagnosis of NAI presenting to KK Women's and Children's Hospital (KKH) from June 2011 to May 2016 was conducted. Results: There were 1917 cases reported from 1730 subjects, of which: 8.8% of subjects had repeat visits; 55.2% of cases were male; and mean age was 7.69 years. Racial demographics were: Chinese 45.5%, Malay 33.4%, Indian 15.4% and Others 5.9%. The most frequent injuries sustained were head and neck (50.8%), limbs (32.2%), and chest (5.7%). Of the type of injuries, 55% had contusions, 21% had cane marks, 16% had lacerations, 4.4% had burn marks and 1% sustained fractures. Males were more likely to be caned (P <0.001); 54.9% of cases were admitted and 38.9% were discharged. Cases that presented without a parent (P <0.001), were known to Child Protective Service (P <0.001), or had a history of parental substance abuse (P = 0.038), mental illness in caregiver (P = 0.021), or domestic violence (P <0.001) were more likely to require admission. Conclusion: Analysing these factors provide a better understanding of the presentation of NAI cases, including 'red flags' and vulnerable groups who should have better protection.

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Key words: Physical abuse, Presentation of child abuse, Risk factors of child abuse

Introduction

Physical abuse constitutes 60% of child maltreatment.[1] In Singapore, the Child Protective Service of the Ministry of Social and Family Development (MSF) has reported an increasing trend of physical abuse cases (confirmed by their child abuse investigations) from 117 in 2012 to 263 in 2015.[2]

Children presenting to the Emergency Department with injuries require a high index of suspicion for clinicians to distinguish those that are abusive in nature. Failure to detect abuse puts children at risk of further serious injury, death and well described negative long-term behavioural and mental consequences of prolonged abuse.[3,4]

Existing local clinical research describing epidemiology, risk factors and presentation[5,6,7] of child physical abuse is sparse. A study[5] on 89 cases of physical abuse admitted to National University Hospital from 2010 to 2012 described the epidemiology and profile of hospitalised patients only. Initial presentation of physical abuse to a Children's Emergency in Singapore has not been described in the literature.

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This study describes the epidemiology of suspected physical abuse cases presenting to the Children's Emergency in KK Women's and Children's Hospital (KKH), Singapore. We specifically describe the injuries, medical encounter, disposition, alleged perpetrators, and risk factors. With this, we hope to improve identification of physical abuse cases amongst emergency personnel.

Materials and Methods

Data Retrieval

This is a retrospective study of children with the clinical diagnosis of non-accidental injury (NAI) who presented to KKH's Children's Emergency from June 2011 to May 2016, as identified from clinical records with this diagnosis code. This diagnosis was based upon corroborated history and clinical findings. For our study, we included all patients with suspected physical abuse by parents, guardians or caregiving figures. We excluded assault by neighbours, school staff and peers and self-harm. We also excluded other forms of child abuse (sexual abuse, emotional abuse and neglect) where physical abuse was absent.

A structured data extraction form was used for data collection by 3 authors. All data collected was cross-checked by a second author for accuracy. Any differences were resolved by discussion among the 3 authors to reach consensus. Variables selected describe the profile of cases and circumstances of presentation (listed in Appendix 1). Risk factors were selected with reference to existing studies[8,9] describing child abuse risks.

Data Analysis

Statistical analysis was performed using the SPSS statistical software programme, version 19 (IBM Corporation, Armonk, NY, USA). Descriptive statistics and univariate analyses were generated using chi-squared tests to compare discrete outcomes, and t-tests were used to compare means across conditions, except for skewed distributions which warrant the use of Kruskal-Wallis test. *P* values were considered statistically significant at <0.05.

Ethics

The study was approved by the SingHealth Centralised Institutional Review Board.

Results

Epidemiology

There were 1917 cases of reported visits, from 1730 patients, of which 187 patients had repeated visits. The mean age was 7.69 years (standard deviation [SD] = 4.12). A breakdown of cases according to yearly trend, ethnicity, time of presentation and disposition are shown in Table 1.

Investigations and Procedures

Of the cases reviewed, 229 (12%) required x-rays in the Emergency Department. Of those requiring x-rays, 124 (54%) had x-rays of the skull, facial bones and/or neck, 158 (69%) limb x-rays, 52 (23%) chest x-rays and 29 (13%) pelvis x-rays. (Full skeletal surveys are not performed at the time of Emergency Department consultation in our centre).

There were 14 cases requiring haematological investigations and 9 requiring biochemical investigations in the context of ruling out differentials of thrombocytopaenia and coagulopathy, 11 required toilet and suturing, and 34 required other wound management.

Alleged Perpetrator

The breakdown of major alleged perpetrators is described in Table 2. Other perpetrators also include siblings (3%), stepmothers (2%), and 9% were unknown.

Of the cases where the biological parents were perpetrators, 626 (51%, $P \leq 0.001$) had a history of domestic violence. Of the cases presenting by 0 to 5 hours, 16% were alleged abuse by fathers, as compared to 11% by stepfathers and 7% each for mothers and domestic helpers,

Table 1. Suspected Physical Abuse: Breakdown of Cases According to Year, Ethnicity, Time of Presentation and Disposition

	Number of Cases (%)
Year	
2012	372
2013	354
2014	370
2015	382
Ethnicity	
Chinese	860 (45)
Malay	652 (34)
Indian	293 (15)
Others	112 (6)
Time of presentation	
<10 hours	354 (19)
10 – 24 hours	344 (18)
24 – 72 hours	412 (21)
3 – 30 days	369 (19)
>30 days	109 (6)
Undocumented	329 (17)
Disposition	
Admission	1051 (55)
Discharge without follow-up	744 (39)
Outpatient clinic follow-up	88 (4)
Abscond	20 (1)
Discharge against medical advice	11 (0.6)

respectively. Of the cases presenting before 24 hours, 46% were alleged abuse by fathers, 32% by domestic helpers, 30% by stepfathers and 30% by mothers, respectively.

There were 595 cases (31%) who came from a nuclear family, while 928 cases (48%) had parents who were divorced/undergoing divorce, and 87 cases (5%) had single parents. There were 294 (42%) whose fathers as the alleged perpetrators were married, and 294 (42%) divorced/awaiting divorce. Conversely, 107 (20%) of the mothers were married and 322 (61%) were divorced/awaiting divorce.

Table 2. Profile of Perpetrators, People Who Highlighted Concern and Injuries Mechanisms

	Number of Cases (%)
Perpetrator	
Father	708 (37)
Mother	530 (28)
Stepfather	146 (8)
Relatives	158 (8)
Domestic helper	117 (6)
Concerns highlighted	
Parents	1056 (55)
Social welfare	521 (27)
Relatives	322 (17)
School	259 (14)
Police/civil defence	205 (11)
Location of alleged injuries	
Head and neck	974 (51)
Limbs	1108 (58)
Chest	395 (21)
Abdominal/pelvis	235 (12)
Tool/body part that inflicted injury	
Hand	671 (35)
Leg	106 (6)
Cane/stick	453 (24)
Household items	199 (10)
Scalding items/liquids	96 (5)
Sharps	26 (1)
Unknown	366 (19)

Fathers were more likely to use body parts (i.e. their hands and legs) to hit their child. A total of 311 (46%) of cases hit by the hand were by fathers, compared to 156 (23%) by mothers. Also, 52 (49%) of the cases hit by the leg were by fathers, compared to 22 (21%) by mothers. Mothers, however, were more likely to use the cane (172 cases, 33%) compared to fathers (152 cases, 22%).

The number of cases injured by cane/stick decreased from 97 in 2012, to 90 in 2013, to 84 in 2014, and 81 in 2015. The trend for injuries by hand generally decreased from 155 in 2012, to 143 in 2013, 88 in 2014, to 128 in 2015. Injuries by household objects were from 31 in 2012, to 29 in 2013, and 44 in both 2014 and 2015.

Of 117 cases with the domestic helper as the alleged perpetrator, 63% (74) were Chinese, 15% (17) Malays and 13% (15) Indians. The most common body parts injured were the limbs (60 cases, 51%) followed by the head and neck (54 cases, 46%). The most common type of injury was contusions (73 cases, 62%). A total of 103 cases (88%) were highlighted by the parents. Eighty-one cases (69%) belonged to nuclear families. Of those cases who were abused by the domestic helper, none had parental history of incarceration, 1 had a history of parental substance abuse, 1 was previously known to Child Protective Service, 3 had more than 2 siblings and 5 had history of domestic violence. Forty-six cases (39%) presented within 48 hours, and 10 cases (9%) presented more than a month later.

Injuries

Reviewing the injuries sustained, 284 (15%) cases had more than 1 type of injury and the breakdown is shown in Table 3. Despite alleged injuries previously, 312 (16%) cases were examined to not bear visible signs or injuries. The mechanism of injuries are listed in Table 2.

Of the cases who presented with cane marks, 54% (218) are Chinese, 30% (119) Malay and 11% (45) Indians. For burn marks, 49% (41) are Malay, 25% (21) Indians and 21% (18) Chinese. Boys were more likely to be caned (276 cases, 61%, P <0.001).

Of the 19 cases of fractures, there were 6 humerus, 3 clavicular, 3 condylar/supracondylar and 1 orbital floor fracture. The racial demographics are 11 Chinese (58%), 7

Table 3. Types of Injuries Sustained in Accordance to Sex and Age Distribution

	Total Cases (%)	Male n (%)	Female n (%)	0 – 1 Year (%)	1 – 5 Years (%)	5 – 10 Years (%)	>10 Years (%)
Total	1917	1066 (56)	851 (44)	82 (4)	488 (26)	740 (38)	607 (32)
Cane	403 (21)	276 (68)	127 (32)	0 (0)	56 (14)	200 (50)	147 (36)
Laceration	314 (16)	180 (57)	134 (43)	17 (5)	86 (27)	115 (37)	96 (31)
Contusion	1055 (55)	578 (55)	477 (45)	35 (3)	278 (26)	381 (36)	361 (35)
Burn	84 (4)	43 (51)	41 (49)	2 (2)	36 (43)	37 (44)	9 (11)
Fracture	19 (1)	11 (58)	7 (42)	6 (32)	4 (21)	6 (31)	3 (16)

Malays (37%) and 1 Indian (5 %). A slight majority of the 11 cases (58%) are boys. Four of the cases were perpetrated by the father, 2 by the stepfather, 3 by the mother and 3 by the domestic helper. Only 10 cases (53%) presented within 24 hours.

There were 20 injuries from bite marks, and the most frequent were found at the head and neck (45%, $P = 0.596$), followed by the limbs (25%, $P = 0.844$) and the chest (15%, $P = 0.007$). The most frequent cane marks were found at the limbs (55%, $P < 0.001$) followed by the head and neck (34%, $P < 0.001$) and chest (5%, $P < 0.001$). Burn marks were most commonly on the limbs (55%, $P < 0.001$), the head and neck (31%, $P < 0.001$) and chest (8%, $P = 0.26$).

Risk Factors

Cases which presented with a parent were more likely to be discharged ($P < 0.001$). Risk factors found to be significant for cases requiring admission are: children with psychological history or behavioural issues, previously known to Child Protective Service, previous history of substance abuse by parents, non-nuclear family, history of mental illness in caregiver and history of domestic violence (Table 4).

Discussion

The above results reveal the types of injuries sustained, prevalent methods of sustaining injury, perpetrator groups, as well as epidemiology and risk factors of those who suffered physical abuse.

Epidemiology

Whilst the number of confirmed physical abuse cases have increased according to MSF,[2] this did not translate to more suspected cases presenting to our hospital. The main likely reason for this is that MSF conducts child abuse investigations only for the more serious cases of abuse; less serious cases are often managed at hospital and/or community agency level, in accordance with MSF guidance. Whilst the number of cases involving MSF has increased, the overall number of cases presenting to our hospital has not.

The racial distribution in Singapore is 74% Chinese, 13% Malays and 9% Indians.[10] In our study, the Malay and Indian populations were over-represented. In the Singapore population census of 2010,[11] the average household size for Malays was 4.2 people—much higher than 3.6 for Indian and 3.4 for Chinese. Considering that our study also revealed that patients with more than 2 siblings was a risk factor, increased household size resulting in parenting stress might help explain this finding.

There was a prevalence of delayed presentation of cases (occurring after 48 and 72 hours) and this was also seen in serious injury cases such as fractures. Seeking medical attention invariably flags up child abuse, and the fear of the implications—such as leading to investigation and legal processes—results in the delay. Also, the severity of injuries may be falsely perceived by caregivers, only to be picked up by others (e.g. school) upon later contact, hence delaying the detection of abuse. Delayed presentation after injury can be a red flag for possible physical abuse in future medical encounters.

Investigations

X-rays performed were according to clinical indication and departmental guidelines; 8% of x-rays detected a fracture. In our centre, full skeletal surveys are conducted

Table 4. Correlation of Risk Factors with Admission

Factors Affecting	Number of Cases (%)	*P* Value of Admission (Odds Ratio, 95% Confidence Interval)	*P* Value of Previously Known by Child Protective Service
Psychological history/behavioural issues	109 (6)	0.004 (1.820, 1.206 – 2.748)	0.018
Special needs	76 (4)	0.015 (1.822, 1.114 – 2.981)	0.154
Developmental delay	40 (2)	0.010 (2.510, 1.220 – 5.164)	0.056
Previous attendance for similar issues	328 (17)	0.005 (1.416, 1.109 – 1.8060)	<0.001
Previous CE attendance of any kind	1477 (77)	0.026 (1.275, 1.030,1.578)	<0.001
Previously known to Child Protective Service	315 (16)	<0.001 (2.034, 1.572 – 2.632)	NA
History of substance abuse by parents	148 (8)	0.023 (1.876, 1.082 – 3.251)	0.019
Non-nuclear family	1323 (69)	<0.001 (0.961, 0.791 – 1.168)	<0.001
History of mental illness in caregiver	97 (5)	0.004 (1.893, 1.219 – 2.941)	<0.001
History of domestic violence	844 (45)	<0.001 (1.520, 1.266 – 1.824)	<0.001
History of incarceration of parents	30 (12)	0.864 (0.939, 0.456 – 1.934)	<0.001
More than 2 siblings	178 (9)	0.211 (1.218, 0.894 – 1.658)	<0.001

CE: Children's Emergency; NA: Not applicable

subsequent to initial Emergency Department consultation, and were outside the scope of our study.

Alleged Perpetrator

Our results revealed that in a greater proportion of cases, the alleged abuse was committed by the father or stepfather rather than the mother or stepmother—a finding that is consistent with other studies in Singapore.[5,6] The societal perception of men as the predominant figures of abuse might allow abuse committed by women to remain undetected for longer periods or not reported at all.[12] Our study also revealed greater delay in presentation times in cases where mothers were the alleged perpetrators, compared to fathers. Women still form a significant proportion of the alleged perpetrators, and should not be accorded a lower index of suspicion.

Despite parental abuse being the majority, abuse by stepparents also formed a substantial proportion of the cases. Our study, however, did not identify if stepchildren were more likely to be abused than biological children of the same abuser. This would be an interesting factor to investigate in further studies.

Abuse by domestic helpers comprised a smaller proportion (6%), as compared to relatives (8%). These cases also have delayed presentation and are mostly highlighted by parents. Unlike other cases, risk factors are minimal in this group. Often, financial stability—as reflected in the family's ability to hire a domestic helper—precludes these risk factors.

Injuries

The number of cases were greatest amongst 5- to 10-year-olds, followed by those older than 10 for the cane, laceration and contusion injuries. The older children also made up the largest proportion of limb, head and neck injuries. The older age group suffered more physical abuse and possible reasons could be that parenting is tougher as the child grows increasingly independent and has a mind of his/her own. They may also be perceived to be less frail and able to withstand physical punishment.

The distribution of fractures was equally high in cases aged less than 1 as compared to cases aged 5 to 10, and did not follow the previously mentioned trend. This could be attributed to trauma in young children with incomplete ossification of bones who would more likely suffer from fractures, as compared to older children who tended to sustain soft tissue injuries.

Contusions formed the majority of the injuries sustained. This was most likely because the majority of mechanism of injury was hitting with hands or kicking with legs. Both caning and hitting with hands showed a decreasing trend over the years; instead there was more use of household objects. These included furniture, daily equipment, clothing, accessories and kitchenware. The possible conclusion could be that physical abuse increasingly might be more unplanned. The impulsive nature of the abuse caused perpetrators to use items generally within reach, and not to deliberately retrieve canes specifically for physical punishment. This could be a sign that our society is moving away from the previously common practice of caning, well described in Tong et al (1996) and Ngiam and Tung (2014).[13,14]

Risk Factors for Admission

Admission to hospital implies a lack of alternative care plans that are safe enough to prevent the child from further abuse—which might represent an imminent threat of further injuries rather than existing ones. Of the factors that were statistically significant, behavioural issues,[15] special needs,[16] domestic violence[17] and substance abuse in the family[18] have been well described. These highlighted groups of vulnerable children deserve attention for better protection from physical abuse.

Mental illness in caregivers is associated with a theorised social drift[19] which puts them in more economically disadvantaged circumstances. Possible emotional dysregulation, irritability, delusions and hallucination disrupt the caregiver's function, leading to conflict.

The proportion of cases belonging to divorced parents (48.4%) was slightly higher than the national divorce rates for males (44.4%) and females (41.6%).[20] Raising children in a non-nuclear family increases stressors for the parent, as compared to a shared burden. There are also considerations of alleged abuse as part of custody battle in divorce process, which might not reflect true physical abuse.

Parental incarceration history did not show any significant correlation and could due to the presence of existing stable care plans already established under jurisdiction, and hence need not require admission.

Limitations

This study is limited by its retrospective nature, where information is only available through documented clinical records, which might be incomplete.

Our study did not look at physical abuse cases that were subsequently diagnosed in the ward (but not at the point of Emergency Department consultation). Such information would be valuable to consider detection rates and factors that resulted in initial missed diagnosis, for improvement of detection at the Emergency Department level in future.

Our study included both suspected and confirmed physical abuse cases. We did not have access to information on the outcome of child abuse investigations conducted by MSF. We did not exclude cases where no evidence of abuse was found upon MSF investigation.

Conclusion

This study analysed the demographics, type of injuries, alleged perpetrators and risk factors related to physical abuse presenting to the Children's Emergency. The data highlighted vulnerable children belonging to groups with significant risk factors and who should have better protection. It also identified red flags such as delayed presentation time for future medical encounters to pay attention to. It also provided a better understanding on the state of child abuse presentation in Singapore, and is useful for future comparisons across Asian countries and internationally.

REFERENCES

1. Rehabilitation and Protection Group, Ministry of Social and Family Development. Protecting Children in Singapore. Available at: https://www.msf.gov.sg/about-MSF/our-people/Divisions-at-MSF/Social-Development-and-Support/Rehabilitation-and-Protection-Group/Pages/default.aspx . Accessed on 1 August 2017.
2. Ministry of Social and Family Development. Child Abuse Investigations. Available at: https://www.msf.gov.sg/research-and-data/Research-and-Statistics/Pages/Child-Abuse-Investigations.aspx. Accessed on 7 July 2017.
3. Ethier LS, Lemelin JP, Lacharite C. A longitudinal study of the effects of chronic maltreatment on children's behavioral and emotional problems. Child Abuse Negl 2004;28:1265-78.
4. Fluke JD, Shusterman GR, Hollinshead DM. Longitudinal analysis of repeated child abuse reporting and victimization: multistate analysis of associated factors. Child Maltreat 2008;13:76-88.
5. Ngiam XY, Kang YQ, Aishworiya R, Kiing J, Law EC. Child maltreatment syndrome: demographics and developmental issues of inpatient cases. Singapore Med J 2015;56:612-7.
6. Li D, Chu CM, Ng WC, Leong W. Predictors of re-entry into the child protection system in Singapore: a cumulative ecological-transactional risk model. Child Abuse Negl 2014;38:1801-12.
7. Sumanth KG, Rakesh R, Arjandas M. Pattern of fractures in non-accidental injuries in the pediatric population in Singapore. Clin Orthop Surg 2014;6:432-8.
8. Sidebotham P, Heron J, ALSPAC Study Team. Child maltreatment in the "children of the nineties": a cohort study of risk factors. Child Abuse Negl 2006;30:497-522.
9. Kahn JM, Schwalbe C. The timing to and risk factors associated with child welfare system recidivism at two decision-making points. Children and Youth Services Review 2010;32:1035-44.
10. Department of Statistics, Singapore. Population Trends, 2016. Available at: http://www.singstat.gov.sg/docs/default-source/default-document-library/publications/publications_and_papers/population_and_population_structure/population2016.pdf. Accessed on 12 July 2017.
11. Department of Statistics, Singapore. Census of Population, 2010. Available at: https://www.singstat.gov.sg/docs/default-source/default-document-library/publications/publications_and_papers/cop2010/census_2010_release2/findings.pdf. Accessed on 12 July 2017.
12. Dugan E. Women can abuse children too – and the society must confront it. Independent, 27 September 2014. Available at : https://www.independent.co.uk/life-style/health-and-families/health-news/women-can-abuse-children-too-and-society-must-confront-it-9760090.html. Accessed on 12 July 2017.
13. Ngiam XY, Tung SS. The acceptability of caning children in Singapore: the fine line between discipline and physical maltreatment. J Dev Behav Pediatr 2016;47:158-63.
14. Tong CK, Elliott JM, Tan PMEH. Singapore Children's Society Research Monograph No. 1: Public Perceptions of Child Abuse and Neglect in Singapore. Singapore: Singapore Children's Society; 1996.
15. Kochanska G, Freisenborg AE, Lange LA, Martel MM. Parents' personality and infants' temperament as contributors to their emerging relationship. J Pers Soc Psychol 2004;85:744-59.
16. Little L. Maternal discipline of children with Asperger syndrome and nonverbal learning disorders. MCN Am J Matern Child Nurs 2002;27:349-54.
17. Hartley CC. The co-occurrence of child maltreatment and domestic violence: examining both neglect and child physical abuse. Child Maltreat 2002;7:349-58.
18. Young NK, Boles SM, Otero C. Parental substance use disorders and child maltreatment: overlap, gaps, and opportunities. Child Maltreat 2007;12:137-49.
19. Perry MJ. The relationship between social class and mental disorder. J Prim Prev 1996;17:17-30.
20. Department of Statistics, Singapore. Singstat, Latest Data, 2016. Available at: http://www.singstat.gov.sg/statistics/latest-data#19. Accessed on 1 August 2017.

Appendix 1 – Variables Extracted

Demographics	• Age • Sex • Ethnicity
Clinical encounter	• Date of visit • Investigations: haematological, biochemical, radiological • Procedures • Medications • Disposition • Diagnosis
Details of the alleged physical abuse	• Body parts injured • Type of injuries sustained • Equipment used • Alleged perpetrator • Time of incident • Timing of presentation • People who highlighted concerns
Medical background of patient	• Past medical history • Special needs • Psychological history • Developmental delay • Previous attendance to the Children's Emergency • Previous physical abuse
Risk factors	• Previously known by Child Protective Service • History of drug abuse by parents • Marital status of parents • History of mental illness in caregiver • History of domestic violence • Incarceration of parents

Letter to the Editor

Periorbital Cellulitis in Paediatric Emergency Medicine Department Patients

Dear Editor,

Periorbital cellulitis is defined as an infection in front of the orbital septum of the eye and is characterised by development of acute eyelid oedema, tenderness, warmth, chemosis and erythema.[1-3] This is a relatively common condition seen in the paediatric population.[4] Periorbital cellulitis has to be promptly distinguished from orbital cellulitis which is an infection occurring posterior to the orbital septum.[5,6,7]

Periorbital cellulitis is usually associated with concurrent local pathologies like chalazion, ethmoid sinusitis, dacrocystitis, facial cellulitis, facial or dental surgical procedures, periocular trauma, impetigo and insect bites.[1,8] A thorough history, meticulous clinical examination and identification of risk factors are paramount in the management of this condition.[9] Treatment is predominantly medical with initiation of prompt antibiotic therapy and addressing the underlying pathology.[2]

The aim of this study was to describe the epidemiology, clinical profile and outcome of children with periorbital cellulitis attending the paediatric emergency medicine department. We also wanted to determine the correlation of clinical severity index score[10] with development of complications.

Materials and Methods

This was a single-centre retrospective study based on data collected at the Children's Emergency department at KK Women's and Children's Hospital (KKH), Singapore between 2006 and 2016. The study was approved by the SingHealth Centralised Institutional Review Board (CIRB). The data collection was started by identifying all patients with discharge diagnosis of periorbital cellulitis or preseptal cellulitis from the discharge diagnosis and then recording information on: demography, symptoms, aetiology, clinical signs, treatment, follow-up and return visit.

Clinical severity index score was calculated for all individual patients by a score validated by Linda Vu et al[10] which included systemic features and local features. All categorical variables were analysed using chi-squared test, while for continuous variables, independent t-test was used. Following this, univariate and multivariate logistic regression analyses were performed, with periorbital cellulitis as the primary outcome.

Results

There were 766 patients identified during the study period with periorbital cellulitis. Among these, 614 (80.2%) patients were managed on an outpatient basis with oral antibiotics and 152 (19.8%) patients needed inpatient admission for intravenous antibiotics during the first visit to Children's Emergency. The lowest age in the study group was 1 month and the highest age was 192 months, with a mean age of 45.08 months. The mean severity index score for the study group was 1.52, with the lowest score of 0 and highest score of 13. The mean age of patients requiring inpatient admission (41.30 months) was less than those that were managed on an outpatient basis (46.03 months) (Table 1). However, the mean severity index score was higher for the inpatient group (2.85) when compared to the outpatient group (1.19) (P <0.001). Most patients in the study group were males (53.3%).

In patients who had fever with temperatures less than 39°C, 83% of patients were managed as outpatients when compared to 17% who required inpatient care. On the other hand, there was a higher admission rate among patients with fever more than 39°C, with 61% managed as outpatients and 39% as inpatients, odds ratio 2.92 (1.89-4.52) (P <0.001).

Eye discharge and upper respiratory tract infection (URTI) symptoms were seen in 36.0% and 27.6% of the patients, respectively. A history of antecedent trauma to the eye or face was found in 4.4%, and insect bite to the periorbital area was found in 13.4% of patients; 7.2% of patients had a history of eye disorders like chalazion, blepharitis, periorbital eczema in the past, and 0.9% had a history of sinusitis (past history or current radiological evidence); 1.5% of patients had undergone recent surgical procedures like dental extraction and face laceration repair. Presence of fever of more than 39°C was seen in 11.8% of patients. Bilateral eye periorbital cellulitis was seen in 16.9% of patients. Associated bulbar and palpebral conjunctival erythema was seen in 43.6% of patients. The antibiotics used for outpatient treatment included: co-amoxiclav in 61.6%, amoxycillin in 5.8%, cloxacillin in 7.2%, cephalexin in 5.2% and clarithromycin in 0.3% of patients.

Among the 614 patients managed on outpatient basis, 155 (25.2%) returned to the emergency department due to progression or non-resolution of symptoms after 48 hours. Of these, 51 (8.3%) patients were admitted for inpatient

Table 1. Outcomes of Periorbital Cellulitis Treated in Emergency Department Compared to Age and Severity Index Score

Variables	Yes/No	n (%)	Mean	Standard Deviation	95% CI for Mean		Minimum	Maximum	*P* Value
					Lower Limit	Upper Limit			
Inpatient admission									
				Age					
	No	614 (80.2)	46.03	36.15	43.16	48.89	1	186	0.164
	Yes	152 (19.8)	41.30	42.26	34.52	48.08	1	192	0.164
				Severity index score					
	No	614 (80.2)	1.19	1.863	1.05	1.34	0	11	<0.001
	Yes	152 (19.8)	2.85	2.656	2.42	3.28	0	13	<0.001
Complications									
				Age					
	No	719 (93.9)	44.59	37.33	41.85	47.32	1	192	0.146
	Yes	47 (6.1)	52.79	38.98	41.34	64.23	1	175	0.146
				Severity index score					
	No	719 (93.9)	1.45	2.07	1.30	1.60	0	11	<0.001
	Yes	47 (6.1)	2.66	2.85	1.82	3.50	0	13	<0.001
Return visit to emergency department									
				Age					
	No	611 (79.8)	47.29	38.74	44.21	50.36	1	192	0.001
	Yes	155 (20.2)	36.43	30.49	31.58	41.26	1	186	0.001
				Severity index score					
	No	611 (79.8)	1.47	2.16	1.30	1.64	0	11	0.191
	Yes	155 (20.2)	1.72	2.11	1.39	2.06	0	13	0.191

CI: Confidence interval

care. Further to that, 317 (51.6%) patients who were managed as outpatients, had no resolution of symptoms during follow-up in the ophthalmology clinic. Among these, 156 (25.4%) patients needed inpatient admission. Hence, overall inpatient admission rate among patients managed as outpatients was 46.8%. The main complication seen in patients with periorbital cellulitis was the development of eventual orbital cellulitis (6.1%). The mean age (52.8) and mean severity index score (2.6) was higher for patients who developed complication during treatment for periorbital cellulitis (P = 0.1 and <0.001, respectively) (Table 1). Among the patients who had return visits to the emergency department, mean age was lower (36.4) (P = 0.001), but the severity index scores were similar (Table 1).

Upon univariate regression analysis, among patients who had no resolution or progression of symptoms with oral antibiotics, history of bites and fever >39°C were risk predictors (Table 2). Trend risk predictor was fever >39°C. Upon multivariate regression analysis, history of bites and fever >39°C persisted to be risk predictors (Table 2).

Discussion

Majority of the patients in our cohort were managed on an outpatient basis with oral antibiotics. The mean age of the patients reported in our study was higher than previously reported.[7] The male predominance in our group of patients is similar to that reported previously.[11] The mean severity index for patients requiring inpatient admission for treatment was higher than those managed on outpatient basis. Comparable results have also been observed in a previous study.[10] Patients who had fever with temperatures of more than 39°C had a higher rate of inpatient admission. Antecedent trauma to face was found only in a minority of patients but this places emphasis on close follow-up patients with facial trauma especially periocular trauma for the development of periorbital cellulitis.[2] The rate of occurrence of insect bite as a predisposing factor in our patients was low when compared to previous studies.[7] The presence of predisposing factors like sinusitis, URTI, past eye disorders like chalazion, blepharitis, periorbital eczema and recent surgical procedures were low in our study as compared to previous studies.[3,11,12] The presence of bilateral eye involvement in patients with periorbital cellulitis has been described in literature and there was bilateral periorbital cellulitis in 16.9% of our patients.[3,13]

Majority of our patients received oral co-amoxiclav for the treatment on an outpatient basis. The infection was caused mainly by *Staphylococcus aureus* and *Streptococcus pyogenes*.[9] The antibiotic of choice should have anti-beta-lactamase activity and be able to cover both *Staphylococcus aureus* and *Streptococcus pyogenes*.[9,14]

Table 2. Summary of Univariate and Multivariable Logistic Regression Analysis for Patients Who Had No Resolution or Progression of Symptoms with Oral Antibiotics

Variables	Univariate Analysis		Multivariate Analysis	
	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value*
Boy	1.0 (0.8 – 1.4)	0.784	1.1 (0.8 – 1.4)	0.743
Eye discharge	1.0 (0.7 – 1.4)	0.961	0.9 (0.7 – 1.4)	0.925
URTI symptoms	1.4 (0.9 – 1.9)	0.064	1.2(0.8 – 1.6)	0.383
Trauma	0.9 (0.5 – 1.9)	0.814	0.9 (0.4 – 1.9)	0.767
History of bites	0.6 (0.4 – 0.9)	0.014	0.6 (0.4 – 0.9)	0.031
Past eye disorders	0.6 (0.3 – 1.2)	0.199	0.7 (0.4 – 1.3)	0.303
Past sinusitis	1.3 (0.3 – 5.7)	0.757	1.1 (0.2 – 5.1)	0.901
Recent surgical procedures	0.8 (0.2 – 2.8)	0.780	1.0 (0.3 – 3.6)	0.974
Fever >39°C	2.5 (1.6 – 3.9)	<0.001	2.3 (1.5 – 3.7)	<0.001
Bilateral eye periorbital cellulitis	0.8 (0.5 – 1.2)	0.385	0.8 (0.5 – 1.2)	0.332
Conjunctival erythema	0.9 (0.7 – 1.2)	0.622	0.8 (0.6 – 1.2)	0.381

CI: Confidence interval; OR: Odds ratio; URTI: Upper respiratory tract infection
*P <0.05 was considered statistically significant.

In our study, 46.8 % of patients managed on an outpatient basis with oral antibiotics had to be eventually admitted due to progression or non-resolution of symptoms after 48 hours. Careful selection of patients for oral ambulatory care is of paramount importance to prevent progression of disease and occurrence of complications. Complications like development of orbital cellulitis, subperiosteal abscess, subacute lid abscess, eyelid necrosis, cicatricial ectropion, retinitis, uveitis, endophthalmitis and optic neuropathy have been described in literature.[15] Extension of disease can result in intracranial complications like cavernous sinus thrombosis or meningitis, sepsis and death.[3,15] The only complication noted in our patients was progression of the disease resulting in development of orbital cellulitis. Clinical severity index score was significantly higher for patients who eventually developed complications during the treatment.

Univariate logistic regression analysis showed that patients with history of bites and fever of more than >39°C were more likely to have no resolution or progression of symptoms with oral antibiotics. On multivariate logistic regression analysis, history of bites and fever of >39°C persisted to be significant risk predictors. We propose that those patients with these risk factors be admitted for inpatient care for intravenous antibiotics and if this is not feasible, they should have the earliest possible clinical reassessment to evaluate for progression of symptoms.

Limitations

This was a retrospective study design and hence limited by the inherent biases related to the design. Patients were identified based on discharge diagnosis. The presenting diagnosis may not have been accurate, hence affecting the results and conclusions.

Conclusion

Our study demonstrated 46.8% admission rate for patients with periorbital cellulitis managed with oral antibiotic outpatient care. The clinical severity index score was significantly higher for patients who needed initial inpatient care and those who developed complications later. The use of clinical severity index score on a regular basis in the emergency department could help identify these at-risk patients. The average severity index score of 6 has been found to be highly predictive of the need for intravenous antibiotics by Vu et al[10] previously. Patients with fever of more than 39°C and history of bites should be admitted for intravenous therapy during the initial visit to the emergency department and if this is not feasible, they should have the earliest possible clinical reassessment to evaluate for progression of symptoms. It is pragmatic to have a standardised hospitalwide protocol for the treatment of patients with periorbital cellulitis so that decisions regarding need for intravenous antibiotics, computerised tomography of the orbit, choice of oral antibiotics for ambulatory care and proximity of follow-up can be uniformly taken by the emergency physician and specialists managing the patients.

REFERENCES

1. Clarke WN. Periorbital and orbital cellulitis in children. Paediatr Child Health 2004;9:471-2.
2. Lee S, Yen MT. Management of preseptal and orbital cellulitis. Saudi J Ophthalmol 2011;25:21-9.

3. Shoaei SD, Tehrani S, Arab-Mazar Z. Frequency of preseptal cellulitis and its risk factors in patients admitted to two educational hospitals in Tehran, Iran, during 2014-2015. Int J Infect 2017;4:e42112.
4. Crosbie RA, Nairn J, Kubba H. Management of paediatric periorbital cellulitis: our experience of 243 children managed according to a standardised protocol 2012-2015. Int J Pediatr Otorhinolaryngol 2016;87:134-8.
5. Koornneef L. Orbital septa: anatomy and function. Ophthalmology 1979;86:876-80.
6. Datner EM, Jolly BT. Pediatric ophthalmology. Emerg Med Clin North Am 1995;13:669-79.
7. Friedel N, Scolnik D, Rimon A, Orbach R, Laat S, Glatstein MM. Are we over-treating insect bite related periorbital cellulitis in children? The experience of a large, tertiary care pediatric hospital. Am J Ther 2017 Apr 25.
8. Cox NH, Knowles MA, Porteus ID. Pre-septal cellulitis and facial erysipelas due to Moraxella species. Clin Exp Dermatol 1994;19:321-3.
9. Howe L, Jones NS. Guidelines for the management of periorbital cellulitis/abscess. Clin Otolaryngol Allied Sci 2004;29:725-8.
10. Vu BLL, Dick PT, Levin AV, Pirie J. Development of a clinical severity score for preseptal cellulitis in children. Pediatr Emerg Care 2003;19:302-7.
11. Chaudhry IA, Shamsi FA, Elzaridi E, Al-Rashed W, Al-Amri A, Arat YO. Inpatient preseptal cellulitis: experience from a tertiary eye care centre. Br J Ophthalmol 2008;92:1337-41.
12. Goodyear PW, Firth AL, Strachan DR, Dudley M. Periorbital swelling: the important distinction between allergy and infection. Emerg Med J 2004;21:240-2.
13. Muzzi E, Parentin F, Pelos G, Grasso DL, Lora L, Trabalzini F, et al. Bilateral orbital preseptal cellulitis after combined adenotonsillectomy and strabismus surgery – case report and pathogenetic hypothesis. Int J Pediatr Otorhinolaryngol 2013;77:1209-11.
14. Carlisle RT, Digiovanni J. Differential diagnosis of the swollen red eyelid. Am Fam Physician 2015;92:106-12.
15. Gonzalez MO, Durairaj VD. Understanding pediatric bacterial preseptal and orbital cellulitis. Middle East Afr J Ophthalmol 2010;17:134-7.

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Bicycle-Related Injuries in Paediatric Patients

Dear Editor,

Cycling is becoming increasingly popular in Singapore. Government bodies are encouraging cycling with the expansion of cycling infrastructure.[1,2] There was an increase in bicycle-related accidents in Singapore by 13% from 2013 to 2014 and by a further 21% from 2014 to 2015.[3] Previous work by Nakayama et al showed that bicycle-related injuries can result in significant disabilities in children, while Shah et al highlighted the large economic costs of such injuries. However, these studies were conducted in countries that do not necessarily share local traffic and road characteristics. We aimed to outline the epidemiology of paediatric bicycle-related injuries in Singapore. The secondary aims of the study were to identify trends with respect to the mechanisms and management of these injuries.

Materials and Methods

This was a retrospective study which utilised data prospectively collected for the purposes of the trauma registry at our institution, which is a level 1 trauma centre in Singapore. The local institutional review board approved the study with a waiver of informed consent. The Domain Specific Review Board number is 2016/00446.

Data regarding paediatric patients (age <18 years) who presented to the Emergency Department (ED) from January 2012 to December 2015 for bicycle-related injuries was reviewed. Only riders or pillions on bicycles were included, while pedestrians were excluded. Data was reviewed for demographics, mechanism and type of injury, pain score, Glasgow Coma Scale (GCS) score, Revised Trauma Score (RTS), imaging investigations, diagnosis, treatment, length of stay (LOS) and survival. Mechanism of injury was classified according to whether a collision occurred.

Results

A total of 733 patients presented to the ED for bicycle-related injuries during the study period; 81 (11.1%) of these patients were paediatric patients. There were 72 males and 9 females. The mean age was 13 years (standard deviation [SD] 4, range 1-17) with a median of 14 years and interquartile range (IQR) of 11 to 15 years (Table 1).

Collisions were the mechanism of injury for 64 patients (79.0%). Collisions with other vehicles being the commonest mechanism, accounted for 56 (69.1%) injuries, 4 of which took place on pedestrian crossings. A small proportion of collisions involved stationary objects (12.5%). The commonest reason for injury without collision was losing balance while riding downhill (6.2%). Within the available data, only 31.3% of patients had worn helmets. There were 8 patients who were pillion riders (9.9%). No patients reported alcohol consumption prior to cycling. However, 1 patient had consumed carbamazepine prior to cycling (Table 1).

Patients who arrived at the ED during the day (0700 hrs to 1900 hrs) made up 58% of the study group. All but 4 patients had a GCS score of 15 at presentation. The remaining patients had GCS scores of 14, 13, 9 and 7, respectively. All patients had a RTS of 7.841, except 3 patients who had scores of 5.967, 6.940 and 7.108. The mean pain score was 3 (SD 3, range 0-10).

Plain films were obtained for 60 (74%) patients, of whom 19 (31.7%) had positive findings of fractures. Computed tomography (CT) scans were required for 11 (14%) patients. This consisted of 4 (5%) patients who required CT scans of only the brain and 7 (9%) patients who required CT scans for multiple regions (Fig. 1). Of the 11 patients who underwent CT scans, 6 (54.5%) had positive findings. The positive findings on CT imaging consisted of intracranial haemorrhage or skull fractures, which had not been already established on physical examination or plain film imaging.

Specialist management was required for 34 (42%) patients. The majority of injuries requiring specialist review were orthopaedic in nature (Table 2). The remaining patients had minor injuries not requiring specialist review. Inpatient admission was required for 20 (24.7%) patients. The patients falling within the 12 to 14 and 15 to 17 age groups contributed to 90% of the admissions. Admission to high dependency (HD) or intensive care unit (ICU) was necessary for 7 (8.6%) patients, of whom 2 required intubation at the ED. The mean LOS among the patients admitted was 4.9 days (SD 5.1, range 1-20) with a median of 3 days and IQR of 2 to 6 days. Surgical management was undertaken for 10 (12.3%) patients during their admission. This consisted of 7 (8.6%) patients who underwent surgery by orthopaedic surgeons, 2 patients by neurosurgeons and 1 patient by plastic surgeons. Of the 10 patients who were admitted but did not undergo surgery, 8 patients had minor head injuries or small volume intracranial haemorrhage and were admitted for neurological monitoring, while 2 patients

Table 1. Patient Demographics and Mechanisms of Injury

Gender	n (%)
Male	72 (88.9%)
Female	9 (11.1%)
Total	81
Age	
1 – 5	8 (9.9%)
6 – 8	7 (8.6%)
9 – 11	6 (7.4%)
12 – 14	24 (29.6%)
15 – 17	36 (44.4%)
Mean (SD)	13 (4%) years
Range	1 – 17 years
Ethinicity	
Chinese	45 (55.6%)
Malay	23 (28.4%)
Indian	9 (11.1%)
Caucasian	3 (3.7%)
Unknown	1 (1.2%)
Collisions	64 (79%)
Car	37 (45.7%)
Heavy vehicle	13 (16%)
Motorcycle	3 (3.7%)
Other bicycle	3 (3.7%)
Non-vehicles	8 (9.9%)
Tree	3 (3.7%)
Lamppost	2 (2.5%)
Other road fixture	3 (3.7%)
No collision	17 (21%)
Riding downhill	5 (6.2%)
Uneven road	3 (3.7%)
No known cause	3 (3.7%)
Foot caught in front wheel	2 (2.5%)
Avoiding other vehicle	2 (2.5%)
Hit by small object (ball)	1 (1.2%)
Slippery ground	1 (1.2%)
Type of bicycle	
Unpowered	80 (98.8%)
Electric	1 (1.2%)
Patient activity	
Rider	73 (90.1%)
Pillion	8 (9.9%)
Helmet use	
Yes	5 (6.2%)
No	11 (13.6%)
Data unavailable	65 (80.2%)
Drugs/alcohol	
Carbamazapine	1 (1.2%)
No	80 (98.8%)

SD: Standard deviation

had fractures not requiring surgery and were admitted for immobilisation of the fractures and management of pain. There were no limb amputations or mortalities among the patients in the study. Further details on injury types and management are summarised in Table 3 and Figure 2.

Discussion

To the best of our knowledge, this is the first study to analyse the epidemiology of paediatric bicycle-related injuries in Singapore.

In our study, paediatric patients contributed to 11.1% of all bicycle-related injuries. Most patients (88.9%) were male, with patients of the 15 to 17 age group accounting for 47.2% of the males. The 12 to 14 and 15 to 17 age groups contributed to form 90% of the patients requiring admission despite only representing 74.1% of the cohort. These findings provide information on the demographic groups that would likely benefit most from targeted interventions aimed at injury prevention. Such interventions can be legislative and non-legislative in nature. Legislative means of injury prevention could include mandatory use of helmets and other safety gear for children aged 12 or older. Such laws have been shown to increase the use of safety gear.[4] In the local context, non-legislative interventions aimed at injury prevention could take the form of compulsory bicycle safety education as a part of the 'Physical Education' syllabus in secondary school. Health education software may be another avenue of intervention in these age groups, with increasing smartphone usage. Such software has been shown to be an effective and low cost means of safety education.[5]

The majority of patients (58.0%) arrived at the ED during the day. Saturday was the commonest day of presentation. The proportion of accidents that took place during national school term breaks was only 21%, despite the term breaks making up approximately 25% of each year. This demonstrates that bicycle injuries among paediatric patients is a perennial problem. We believe that this may be secondary to the use of bicycles for daily transportation purposes as opposed to solely leisure purposes.

In our study, 87.5% of collisions involved another vehicle, of which 7% occurred on pedestrian crossings. This is in contrast to figures from a study conducted in Hong Kong, in which only 31.4% of collisions involved another vehicle.[6] Published figures from a study conducted in Canada reported that 86.2% of bicycle collisions involved another vehicle, which was more similar to figures from our own study. In addition, 4.9% of our patients sustained collisions while cycling across pedestrian crossings. No similar circumstances were reported in the other studies.[6,7] The high proportion of collisions involving other vehicles and collisions occurring on pedestrian crossings in our study—which exceeds those observed in other studies—may

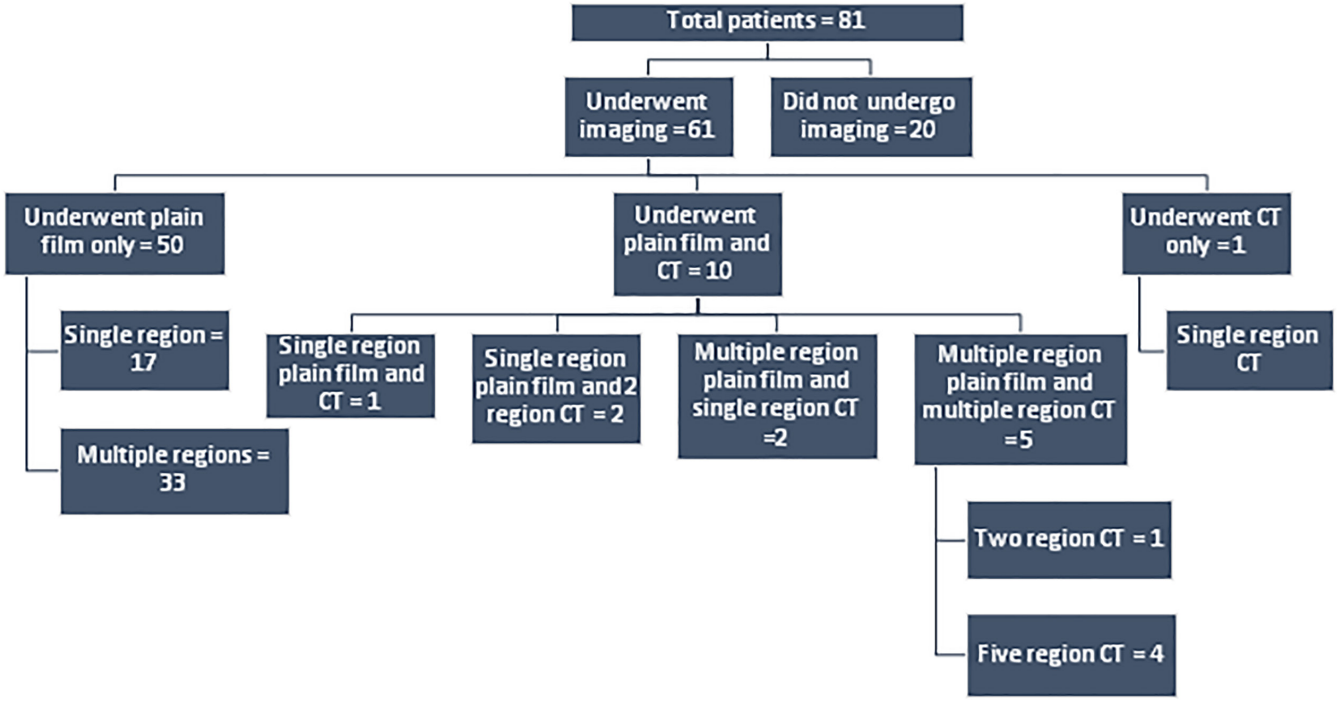

Fig. 1. Chart illustrating the imaging studies. All patients who underwent CT of a single region underwent CT brain. All patients who underwent CT of 2 regions underwent CT brain and cervical spine. All patients who underwent CT of 5 regions underwent CT brain, cervical spine, thorax, abdomen and pelvis. CT: Computed tomography.

Table 2. Orthopaedic Injuries

			Management	
Fractures	**Closed**	**Open**	**Non-Surgical**	**Surgical**
Upper limb				
Clavicle	5	0	5	0
Humerus	2	0	1	1
Humerus and forearm	1	0	0	1
Forearm	3	0	1	2
Hand	0	1	0	1
Lower limb				
Femur	1	0	0	1
Leg	0	1	0	1
Foot	4	0	4	0
Others	**Closed**	**Open**	**Non-Surgical**	**Surgical**
Ankle sprain	-	-	2	0
Posterior cruciate ligament tear	-	-	1	0

be attributed to the density of motor vehicles in Singapore. Another possible contributory factor is that drivers of motor vehicles in Singapore—where bicycles have not yet become a regular mode of transportation—may be less accustomed to sharing roads with bicycle users.

Data on helmet wear was only available for 19.8% of patients. For these patients, over two-thirds had not used helmets. Only 1 of these patients was documented to have been given advice to wear a helmet in future. A recent systematic review showed that bicycle helmet use was associated with reduced odds of head injury, fatal head injury and facial injury.[8] The American Academy of Pediatrics recommends counselling parents and children about the prevention of common childhood injuries, including bicycle safety and helmet use as part of 'The Injury Prevention Program'.[9] It could be beneficial to ensure

Table 3. Surgical Management and Indications

	Indication	Surgery
Orthopaedic surgery		
	Closed left supracondylar fracture	Closed reduction and K-wire fixation
	Closed left olecranon and medial epicondyle fractures with elbow dislocation	Closed reduction and internal fixation
	Closed right radius and ulna fracture	Closed reduction and titanium elastic nail system nailing
	Closed left radius and ulna fracture	Closed reduction and titanium elastic nail system nailing
	Open right ring finger middle phalanx fracture	Wound debridement and K-wire fixation
	Closed right femur shaft fracture	Closed reduction and intramedullary nailing
	Open right tibia and fibula fractures	Wound debridement and external fixation
Neurosurgery		
	Skull fracture with extradural haemorrhage	Posterior fossa craniectomy and evacuation of extradural haemorrhage
	Skull fracture with extradural and subdural haemorrhage	Intracranial pressure monitor insertion
Plastic surgery	Columella laceration	Toilet and suture

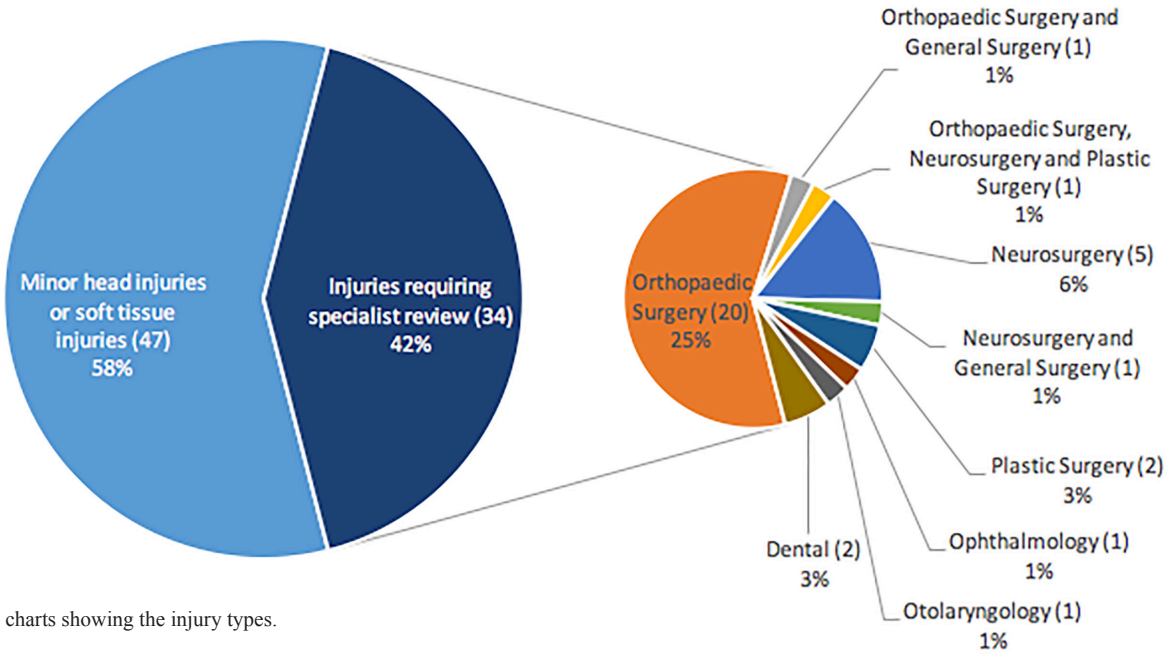

Fig. 2. Pie charts showing the injury types.

that patients and parents are educated on helmet use, in the setting of paediatric patients presenting to the ED for bicycle-related injuries.

Pillion riders contributed to 9.9% of the patients. The majority of these patients were of younger age groups. Only 1 pillion rider was older than 9 years of age. The injury mechanism for all these patients was collisions with other vehicles. These injuries are particularly concerning as the Road Traffic Act in Singapore prohibits pillion riders on bicycles unless the bicycle is designed with an extra seat for the pillion rider.[10] Unfortunately, our data did not include information on the presence or absence of an extra seat on the bicycles involved in the abovementioned accidents. This is an area that warrants further investigation.

The majority of patients (74%) required imaging investigations for further evaluation. A significant proportion of patients in our study (14%) required CT imaging. Of these patients, 54.5% had positive findings that were not already established. CT imaging as part of evaluation following bicycle-related injuries is important but is associated with high levels of radiation and contributes to healthcare system burden. In addition, CT imaging in paediatric patients has been shown to increase risk of certain malignancies.[11] Our figures compared favourably with figures from studies by Fenton et al and Muhm et al, which reported lower figures of 46% and 33.8% for positive CT findings in paediatric trauma patients.[12,13] This demonstrates that CT scans are being used judiciously in our institution in this context,

which may help to ameliorate the burden of paediatric bicycle injuries on the healthcare system and on patients who sustain these injuries.

A quarter of our patients required inpatient admission, with 7 (8.6%) patients being admitted to either HD or ICU. There was a total of 29 days of HD or ICU stay among all the patients. Half of the patients who were admitted underwent surgery. Fixation of limb fractures accounted for 70% of the surgeries performed. A previously conducted study in Singapore on trauma admissions to the surgical ICU demonstrated a mortality rate of 35.7% for patients who had sustained bicycle injuries.[14] Although we had no mortalities among our study population, these findings demonstrate the potential severity of such injuries and further illustrates the burden that such injuries can place on the healthcare system.

Our study is limited by its retrospective nature and data from a single centre. The study cohort may not be representative of affected paediatric patients in the entire country. Despite these limitations, the strength of this study is in its contribution of new information to a topic of growing importance but with little existing data.

Conclusion

Bicycle injuries are a significant cause of morbidity in the paediatric population in Singapore. Males of the 15 to 17 age group have a higher incidence of bicycle-related injuries and may benefit from targeted interventions. Helmet use while cycling is a potential area of education and injury prevention. A notable proportion of injuries require investigations that involve high levels of radiation, admission and surgical management.

REFERENCES

1. Urban Redevelopment Authority. Cycling For All. Available at: https://www.ura.gov.sg/uol/master-plan/view-master-plan/master-plan-2014/master-plan/Key-focuses/transport/Transport/Cycling-for-all. Accessed on 10 October 2017.
2. Land Transport Authority. Land Transport Master Plan, 2013. Available at: https://www.lta.gov.sg/content/ltaweb/en/about-lta/what-we-do/ltmp2013.html. Accessed on 10 October 2017.
3. Department of Statistics, Singapore. Yearbook of Statistics Singapore, 2016. Available at: http://www.singstat.gov.sg/publications/publications-and-papers/reference/yoscontents. Accessed on 10 October 2017.
4. Rodgers GB. Effects of state helmet laws on bicycle helmet use by children and adolescents. Inj Prev 2002;8:42-6.
5. McLaughlin KA, Glang A. The effectiveness of a bicycle safety program for improving safety-related knowledge and behavior in young elementary students. J Pediatr Psychol 2010;35:343-53.
6. Loo BPY, Tsui KL. Bicycle crash casualties in a highly motorized city. Accid Anal Prev 2010;42:1902-7.
7. Aultman-Hall L, Kaltenecker MG. Toronto bicycle commuter safety rates. Accid Anal Prev 1999;31:675-86.
8. Olivier J, Creighton P. Bicycle injuries and helmet use: a systematic review and meta-analysis. Int J Epidemiol 2017;46:278-92.
9. American Academy of Pediatrics. TIPP – The Injury Prevention Program. Available at: https://patiented.solutions.aap.org/handout-collection.aspx?categoryid=32033. Accessed on 10 October 2017.
10. Singapore Statutes Online. Road Traffic (Bicycles) Rules. Available at: https://sso.agc.gov.sg/SL/276-R3. Accessed on10 October 2017.
11. Pearce MS, Salotti JA, Little MP, McHugh K, Lee C, Kim KP, et al. Radiation exposure from CT scans in childhood and subsequent risk of leukaemia and brain tumours: a retrospective cohort study. Lancet 2012;380:499-505.
12. Muhm M, Danko T, Henzler T, Luiz T, Winkler H, Ruffing T. Pediatric trauma care with computed tomography – criteria for CT scanning. Emerg Radiol 2015;22:613-21.
13. Fenton SJ, Hansen KW, Meyers RL, Vargo DJ, White KS, Firth SD, et al. CT scan and the pediatric trauma patient – are we overdoing it? J Pediatr Surg 2004;39:1877-81.
14. Tan WT, Choy JML, Foo JM. A 5-year profile of trauma admissions to the surgical intensive care unit of a tertiary hospital in Singapore. Ann Acad Med Singapore 2010;39:363-7.

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Papular Purpuric Glove and Socks Syndrome with Evolution into Pemphigus Vulgaris

Dear Editor,

Papular purpuric gloves and socks syndrome (PPGSS) is an uncommon acute dermatosis characterised by symmetrical painful erythematous papules on the hands and feet which evolve to sharply demarcated pruritic lesions at the wrist and ankles.[1] These cutaneous manifestations are often accompanied by fever, lymphadenopathy and oral mucosal lesions. It has also been associated with dysuria, vulvar oedema and erythema.[2]

A 36-year-old Chinese female—with no significant medical history of note—was seen for itchy rashes over her hands and feet for 2 weeks, associated with painful oral ulcers for 2 days. She was otherwise afebrile and systemically well with no localising signs of infection. No new drugs or traditional medications were started prior to the onset of the rash. Clinical examination revealed confluent erythema on the palms and soles with sharp demarcation at the wrists and ankles (Figs. 1a and 1b). Multiple erosions and ulcers were found on her lips (Fig. 1c), buccal mucosa and hard palate. There were no palpable lymph nodes or conjunctivitis. Laboratory tests revealed mild lymphopaenia, suggestive of a viral aetiology, with normal levels of C-reactive protein (CRP), erythrocyte sedimentation rate (ESR) and liver function test. Syphilis and retroviral screen was negative. Histology of the palmar lesions revealed non-specific changes of spongiotic dermatitis with eosinophils and extravasated red cells (Fig. 2). Parvovirus B19 polymerase chain reaction (PCR) was negative. Her palmoplantar rashes improved with moisturisers and gradually resolved over the next 1-2 weeks. However, her oral erosions persisted despite regular antiseptic mouth gargle and topical steroids. In view of the active progression of oral lesions, an oral mucosa biopsy was performed. Histology of the mucosal epithelium revealed suprabasal acantholysis with basal keratinocytes exhibiting a "tombstone" appearance. They stained positively on AE1/3 stain, and negatively for herpes type 1 (HSV 1) and herpes type (HSV 2). There was a dense upper dermal infiltrate of lymphocytes suggestive of pemphigus vulgaris (PV) (Figs. 3a and 3b). PCR assays for herpes simplex virus, enterovirus, human immunodeficiency virus and parvovirus B19 were negative; serologies for parvovirus B19 and Epstein Barr virus (EBV) were also negative. Her desmoglein 1 antibody levels were 5.7 RU/mL (equivocal range: 14-20 RU/mL) and her desmoglein 3 antibody levels were 50.4 RU/mL (equivocal range: 9-20 RU/mL). Her indirect immunofluorescence (IIF) with monkey oesophagus substrate was positive, showing an intercellular pattern and a 1/20 titre. Her direct immunofluorescence (DIF) was negative. She subsequently developed tiny erosion over her

Fig. 1. Clinical photos of the patient. A) Confluent erythema seen on the palms. B) Confluent erythema present on the soles. C) The lips reveal multiple erosions and ulcers.

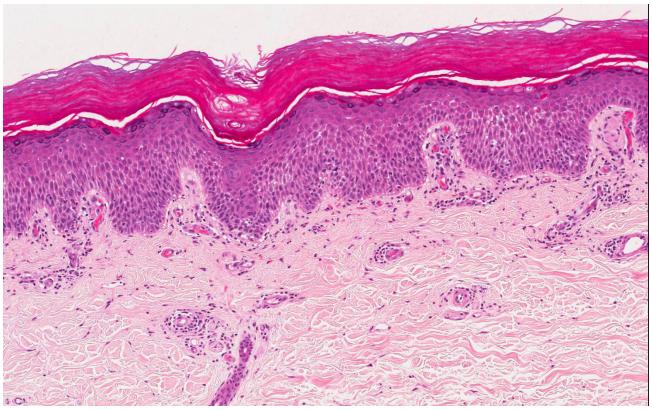

Fig. 2. Hematoxylin and eosin staining, x100 magnification. Histology of palmar lesions revealing non-specific changes of spongiotic dermatitis with eosinophils and extravasated red cells.

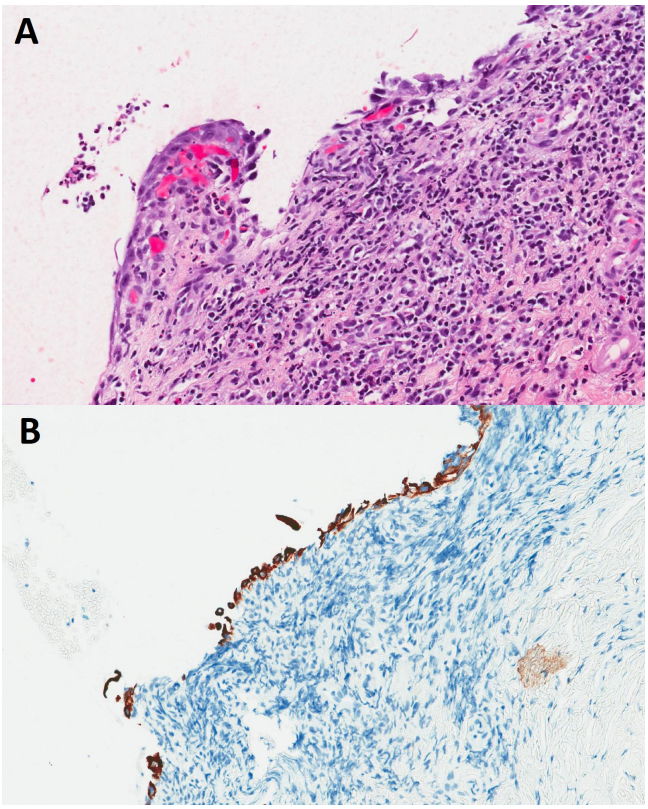

Fig. 3. Histology findings suggestive of pemphigus vulgaris. A) Hematoxylin & eosin staining, x200 magnification. Suprabasal blister with "tombstone" appearance of basal keratinocytes and upper dermal lymphocytic infiltrate suggestive of pemphigus vulgaris. B) Cytokeratin AE1/AE3 staining, x200 magnification. Suprabasal blister with "tombstone" appearance of basal keratinocytes and upper dermal lymphocytic infiltrate suggestive of pemphigus vulgaris.

clitoris with no other cutaneous lesions. Oral prednisolone was started at 30 mg (0.56 mg/kg/day) initially, with the subsequent addition of mycophenolate mofetil (MMF) for control of her condition. She is currently taking prednisolone 17.5 mg/day and MMF 1.5 g BD.

Our patient presented initially with clinical features indicative of PPGSS with acral confluent erythematous plaques clearly demarcated at the wrists and feet. The diagnosis was supported by her blood tests, histology report and the spontaneous resolution of the palmoplantar rashes. The mainstay of treatment in PPGSS is symptomatic, with spontaneous resolution and no long term sequelae.[3] The oral mucosal lesions, suggestive of PV in our patient, propose a causal link between PPGSS and PV. It is highly possible that both conditions were triggered by the same virus in our patient. In addition to parvovirus B19 infection identified as a trigger for PPGSS, other viruses such as measles virus, hepatitis B virus, coxsackie B virus, EBV and cytomegalovirus (CMV) have also been identified.[4] Viral particles were found in vessel endothelium and in basal cell of the epidermis, suggesting that PPGSS might be due to the virus itself or a response to circulating immunocomplexes.[3] PV, on the other hand, is an autoimmune bullous disease characterised by acantholysis and blister formation within the epidermis. It involves autoantibodies targeted against desmoglein 1 and desmoglein 3, proteins involved in cell adhesion structure. A viral aetiology has been suggested for PV and it has been hypothesised that mimicry between viral and epidermal proteins causes overactivation of the immune system involving interferons. However, attempts to detect viruses in blood, skin or fluid lesions have yielded inconclusive results.[5]

To our knowledge, this is the first observation of PPGSS evolving into PV and further studies may be performed to investigate a possible causal link between the 2 conditions.

REFERENCES

1. Harms M, Feldmann R, Saurat JH. Papular-purpuric 'gloves and socks' syndrome. J Am Acad Dermatol 1990;23:850-4.
2. Vassilev TV, Beilke MA, Garcia-Diaz JB. A 35-year-old woman with fever, joint pain and rash. Infect in Med 2001;18:339-43.
3. Santonja C, Nieto-Gonzalez G, Santos-Briz A, Gutierrez Zufiaurre Mde L, Cerroni L, Kutzner H, et al. Immunohistochemical detection of parvovirus B19 in "gloves and socks" papular purpuric syndrome: direct evidence for viral endothelial involvement. Report of three cases and review of the literature. Am J Dermatopathol 2011;33:790-5.
4. Feldmann R, Harms M, Saurat JH. Papular-purpuric "gloves and socks" syndrome: not only parvovirus B19. Dermatology 1994;188:85-7.
5. Sagi L, Sherer Y, Trau H, Shoenfeld Y. Pemphigus and infectious agents. Autoimmun Rev 2008;8:33-5.

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Patient-Surrogate Agreement in Advance Care Planning: Who Are the Surrogates and Are They Making the Right Decisions?

Dear Editor,

Surrogate decision-making based on "substituted judgment" is the concept where surrogates choose the treatment the patient would most want to receive when the patient becomes incompetent.[1] The surrogate decision-making process assumes that the surrogate understands the patient's values and beliefs and uses them to derive the patient's end-of-life care preferences. However, studies have shown poor concordance between what individuals would choose in critical medical situations and what proxies would choose for them.[2-4] A review found that proxies could accurately report some aspects of the end-of-life patient's experience, but these reports were subjected to multiple biases.[5] From the observed differences between surrogates' and patients' choices, validity of substituted judgment is in question.

In Singapore, limited evidence on the effectiveness has been found from a few studies[6-8] conducted on advance care planning (ACP), a nationwide initiative that was recommended to be implemented to be a part of standard care. Most studies that have been conducted on patient-surrogate agreement on preferences were done overseas[9-11] and a few focused on end-of-life patients. The purpose of this study is to examine the extent of agreement between end-of-life patients and their surrogates on the patient's preferences in ACP.

Materials and Methods

Setting and Recruitment

In this cross-sectional study, participants consisted of pairs of end-of-life patients and their surrogates recruited from the ACP department of an acute hospital in Singapore. Patients who were assessed to be "not surprised if they die in the next one year" were referred by the primary care team to the ACP department.

The patients were eligible for the study if they were communicative, spoke either English and/or Mandarin Chinese, selected a surrogate for the ACP session, and were at end-of-life. Patients with a history of psychiatric-related illnesses were also excluded. Surrogates were eligible if they were 18 years of age or older and could speak either English or Mandarin Chinese.

Procedure

At 30 minutes before the ACP session, a trained researcher asked the patient-surrogate pair to participate in the study. Both the patient and the surrogate who agreed to enrol in the study gave written informed consent. Demographic data collected from the patient's case record included age, race, and gender while the clinical data included Geriatric Depression Scale (GDS-7) score, Abbreviated Mental Test score, and the Modified Barthel Index (MBI-20) score. These clinical data were collected to understand the patient's state of psychological and physical health at the point of the study.

The surrogate filled in a survey form in a separate room from the patient. The survey included surrogates' sociodemographic status, a rating of how well the surrogate knows the patient, and the patient's wishes on end-of-life care based on their understanding of the patient. The survey took about 20 minutes to answer. During the ACP session, an experienced ACP facilitator would discuss and document the patient's preferences on end-of-life care. The preferences documented during the ACP were then compared to the surrogates' survey responses.

Data Analysis

Descriptive statistics such as frequencies, proportions, and means (standard deviations) were used to characterise the study participants. Medians were used to describe non-parametric data. Agreement between patients and surrogates on the patient's ACP preferences was analysed in contingency tables and characterised using percent agreement and Cohen's kappa coefficient. For the agreement analysis, when statistically significant, an absolute k value between 0.1 and 0.3 was considered as mild agreement; 0.31 to 0.6 as moderate; 0.61 to 0.8 as good; and 0.8 to 1.0 as excellent. To test for statistically significant systematic differences between patient and family choices, the Wilcoxon matched-pairs signed rank test was used.

Results

Participant Characteristics

Thirty patient-surrogate pairs participated in the study between January 2015 to January 2018. Patients were mainly Chinese (70%) and male (60%) (Table 1). Median

Table 1. Characteristics of Patients

	Patient n = 30
Median age (range)	80 (59 – 97)
Gender (%)	
Female	12 (40)
Ethnicity (%)	
Chinese	21 (70)
Malay	5 (16)
Indian	3 (10)
Others	1 (3)
Median Geriatric Depression Scale score (range)	1 (0 – 7)
Median Modified Barthel Index score (range)	12.5 (1 – 20)

age of the patients was 80 (range 59-97) and the median MBI-20 score was 12.5 (range 1-20). The median GDS-7 score was 1 (range 1-7). Surrogates were of the median age of 50 (range 22-73) and 60% of them were children of the patients (Table 2).

The patient and the surrogate choices and the corresponding kappa values on the agreement are shown in Table 3. Higher kappa values indicate better patient-surrogate agreement. We took on a conservative approach for agreement and only considered good to excellent agreement as acceptable in this study. Surrogates had a mean rating of 4.0 (range 3.0-5.0) when asked on a 5-point Likert scale on how well they think they know the patient, with 1 being not well at all and 5 being very well. Twenty (66.7%) surrogates rated "well" and "very well". However, in these patient-surrogate pairs, we did not find good agreement in all the

Table 2. Characteristics of Surrogates

	Surrogate n = 30
Age (range)	50 (22 – 73)
Gender (%)	
Female	17 (57)
Marital status (%)	
Married	21 (70)
Single/divorced	7 (23)
Highest attained education level (%)	
Primary	6 (20)
Secondary	8 (27)
Tertiary	11 (37)
Relationship to patient (%)	
Child	18 (60)
Parent	3 (10)
Spouse	5 (17)
Sibling	1 (3)
Living in same household as patient (%)	18 (60)
Main caregiver for patient (%)	14 (47)

preferences. This reflects inaccuracy in the surrogate's prediction of the patient's choice even if the surrogates perceived that they know the patient well. Of these pairs, only 11 (55%) were the patient's main caregiver and this could explain the inaccuracy.

Kappa values for the extent of agreement on end-of-life care preferences ranged from 0.09 to 0.62 with an average of 0.37, indicating poor to good consistency in preferences. Only 40% of the patient-surrogate pairs agreed that the patient would not want to be attempted cardiopulmonary resuscitation (CPR) during a medical crisis. Cohen's Kappa could not be calculated as 100% of the patients chose the same preference (i.e. do not attempt CPR). Significant differences (P <0.01) were found in the patient and surrogate choices in CPR status and hence implied that most surrogates were not able to predict the patient's choice in CPR status.

On the patient's views on type of medical intervention, 56.7% of the patient-surrogate pairs agreed (with majority agreeing on the option "limited trial of intervention" [k = 0.09, 95% CI 0.00-0.46]). Moderate agreement was seen in the patient's and surrogate's reported choices on patient's place of medical intervention (k = 0.40, 95% CI 0.17-0.63). However, differences between the patient and surrogate choices on trial of care and place of medical intervention were insignificant.

Fifty percent of the pairs agreed on the option of place of death and good agreement was observed (k = 0.62, 95% CI 0.45-0.94). Of this, majority of the agreement was on "no preference on the place of death". In summary, of the 4 preferred plans of care preferences, most of the surrogates could only predict accurately the patient's preferred place of death. However, since more than half (57%) of the patients did not have a preference on place of death, they may not view dying in place as important as other end-of-life care preferences.

Discussion

We included end-of-life patients in the study as they are nearing death and more likely to have a better grasp of their end-of-life preferences. In terms of acceptability, exploratory studies in patients with advanced cancer have found ACP discussions acceptable and feasible.[12]

Our findings revealed important patterns in disagreement and implied issues in surrogate decision-making. Surrogates tended to overestimate the patient's preference on CPR status and we postulate that they may hold an unduly high expectation of the efficacy of life-saving interventions. Surrogates' knowledge of CPR—including the indications for and the outcomes of CPR—has been found to be poor. Patients and families believed that the success rate for CPR exceeds 50%[13] although many studies have shown that the likelihood of surviving CPR is near to zero.[14] This advocates

Table 3. Preferences in Advance Care Planning

Preference	Patient n = 30	Surrogate n = 30
1. Options regarding cardiopulmonary resuscitation (%)		
To proceed with CPR, attempt resuscitation	0 (0)	6 (20)
Do not attempt CPR, allow natural death	30 (100)	24 (80)
2. Options regarding medical intervention (%)		
Full treatment	1 (3)	9 (30)
Limited medical intervention	26 (87)	17 (57)
Comfort measures only	3 (10)	4 (13)
3. Options regarding preferred place of medical treatment and care (%)		
Transfer to hospital	9 (30)	9 (30)
Trial or treatment in own home/nursing home/hospice	10 (33)	5 (17)
Remain in my own home	4 (13)	13 (43)
No preference	6 (20)	3 (10)
Others	1 (3)	0 (0)
4. Options regarding preferred place of death (%)		
Hospital	3 (10)	2 (7)
Own home	9 (30)	19 (63)
No preference	17 (57)	9 (30)
Hospice	1 (3)	0 (0)

CPR: Cardiopulmonary resuscitation
Note: Because of rounding, not all percentages total 100.

a need to continue improving substitute decision-making so that patients can be more confident that surrogates can make decisions consistent to their wishes.

This study suggested inadequacy in educating surrogates on their role in the ACP process. While it is recognised that an important outcome of ACP is to improve surrogates' knowledge of patients' illness, prognosis and the corresponding life-saving/comfort care procedures, few studies were conducted to measure knowledge. Further research should work on developing an instrument to measure patients' and surrogates' knowledge at pre- and post-ACP. Further research should also look into social factors related to discordances and roles of other surrogates (e.g. clinical personnel, family members and caregivers) in the medical encounter.

Difficulty in recruiting participants for this study limited its sample size. Surrogates refused participation due to the concern that the study may cause a burden to the patient. Due to the high refusal rate, self-selection bias is a concern in this study. The findings cannot be generalised as they come from a non-representative, local sample of patients and surrogates.

Conclusion

Surrogates' understanding of patient preferences are often inaccurate, likely a result of inadequate knowledge that arose from lack of surrogate education during an ACP. Further research would be to measure ACP's effectiveness in improving surrogates' knowledge on their role, patient's illness and life-saving/comfort care procedures.

REFERENCES

1. Torke AM, Alexander C, Lantos J. Substituted judgment: the limitations of autonomy in surrogate decision making. J Gen Intern Med 2008;23:1514-7.
2. Foo AS, Lee TW, Soh CR. Discrepancies in end-of-life decisions between elderly patients and their named surrogates. Ann Acad Med Singapore 2012;41:141-53.
3. Li LL, Cheong KY, Yaw LK, Liu EH. The accuracy of surrogate decisions in intensive care scenarios. Anaesth Intensive Care 2007;35:46-51.
4. Fried TR, Redding CA, Robbins ML, O'Leary JR, Iannone L. Agreement between older persons and their surrogate decision□makers regarding participation in advance care planning. J Am Geriatr Soc 2011;59:1105-9.
5. George LK. Research design in end-of-life research: state of science. Gerontologist 2002;42:86-98.
6. Dixon J, Karagiannidou M, Knapp M. The effectiveness of advance care planning in improving end-of-life outcomes for people with dementia and their carers: a systematic review and critical discussion. J Pain Symptom Manage 2018;55:132-150.e1.
7. Robinson L, Dickinson C, Rousseau N, Beyer F, Clark A, Hughes J, et al. A systematic review of the effectiveness of advance care planning interventions for people with cognitive impairment and dementia. Age and Ageing 2012;41:263-9.
8. Weathers E, Caoimh R, Cornally N, Fitzgerald C, Kearns T, Coffey A, et al. Advance care planning: a systematic review of randomised controlled trials conducted with older adults. Maturitas 2016;91:101-9.

9. Fried TR, Redding CA, Robbins ML, O'Leary JR, Iannone L. Agreement between older persons and their surrogate decision makers regarding participation in advance care planning. J Am Geriatr Soc 2011;59:1105-9.
10. Schmid B, Allen RS, Haley PP, DeCoster J. Family matters: dyadic agreement in end-of-life medical decision making. Gerontologist 2010;50:226-37.
11. Engelberg RA, Patrick DL, Curtis JR. Correspondence between patients' preferences and surrogates' understandings for dying and death. J Pain Symptom Manage 2005;30:498-509.
12. Jones L, Harrington J, Barlow CA, Tookman A, Drake R, Barnes K, et al. Advance care planning in advanced cancer: can it be achieved? An exploratory randomized patient preference trial of a care planning discussion. Palliat Support Care 2011;9:3-13.
13. Frank C, Heyland DK, Chen B, Farquhar D, Myers K, Iwaasa K. Determining resuscitation preferences of elderly inpatients: a review of the literature. CMAJ 2003;169:795-9.
14. Murphy DJ, Burrows D, Santilli S, Kemp AW, Tenner S, Kreling B, et al. The influence of the probability of survival on patients' preferences regarding cardiopulmonary resuscitation. N Engl J Med 1994;330:545-9.

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