



The Galle Medical Journal

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Editors in Chief; Galle Medical Journal

Satish K Goonesinghe

Eisha I Waidyarathne

Editorial

The pandemic and beyond; ethical challenges, racial disparities

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As the world enters its sixth month of living with the threat of COVID-19, we have come to know many facets about the disease while there are many unknown areas as well. It is broadly known that herd immunity probably won't work; who the vulnerable groups are; social distancing works; mutation fears are unfounded and testing is the key. At the same time, it is not known how long immunity lasts; the definite timing of a vaccine and a potential second wave - with many geographical variations. This issue of the *GMJ* features two *Perspective* articles looking at different aspects of the pandemic. The very nature of the current pandemic has posed ethical challenges and dilemmas calling for different approaches deviating from normative practices. Mohideen and Ng Yiwey consider this aspect focusing on public health actions, research initiatives and healthcare worker vulnerability. Hewa analyses the disparity of COVID-19 related mortality between African Americans and Whites in the United States. A similar trend has been observed in the United Kingdom too, with a higher mortality in the ethnic minorities. It is bound to take some time for us to fully comprehend all aspects of the disease process. As we all aware, the pandemic has left a destructive trail globally with unprecedented social and economic ramifications.

The two leading articles have an underlying common theme related to surgical endocrinology: Ratnatunga makes a case for quality assurance of iodination of salt with a view of primary prevention of thyroid disease. Fernando in his article calls for screening and early treatment of primary hyperparathyroidism, clinical features of which can be mild and elusive. Alwis in a detailed review, presents her comprehensive work on factors that contribute to the ability of bone to resist fracture or 'whole bone strength' - going beyond mere bone mass. The original papers feature research on memory tests, measurement of psychosocial burden of chronic lymphoedema in filariasis and different aspects of maternal competence.

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S Sureka Samanmalie

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Editors in Chief/ GMJ

GALLE MEDICAL JOURNAL: INSTRUCTIONS TO AUTHORS

The *Galle Medical Journal* is published by the Galle Medical Association. The *Journal* is published quarterly in March, June, September and December each year. Submissions are accepted throughout the year. The aims of the journal are to foster co-operation among the medical fraternity and to be a forum to make literary contributions, share experiences encountered in medical practice, update their knowledge and have debates on topics related to all aspects of medicine. Also, we attempt to cater to the educational needs especially of the postgraduate trainees. The *Journal* publishes original articles, reviews, leading articles and case reports. When an article is submitted for publication, we expect that the work it reports has not been published, submitted simultaneously to another journal or accepted for publication elsewhere. All manuscripts will be reviewed anonymously before acceptance.

Manuscripts must be submitted with the text typed in 12-point Times New Roman font double spaced. Text and all illustrative material should be submitted in two hard copies and the electronic version in *Microsoft Word* document format. In order to avoid delay we require authors to comply with the following requirements. **All manuscripts should accompany a covering letter indicating the number of words in the manuscript, institution where ethical clearance was granted, conflict of interests and contact details of the corresponding author.**

Types of contributions:

Review articles and Leading articles: We encourage submission of review or leading articles which are less than 3000 words in length and address topics of current interest. They should be supported by no more than 20 references. Submissions may be subjected to external review before acceptance.

Original articles: Should normally be in the format of introduction, methods, results and discussion. Each manuscript must have a structured abstract of 200 words. The text should be limited to 3000 words and maximum of 5 tables/ figures taken together with no more than 15 references. Lengthy manuscripts are likely to be returned for shortening. The discussion in particular should be clear, concise and should be limited to matters arising directly from the results. Avoid discursive speculation.

Case Reports: These should not exceed 750 words and 5 references; no abstract is required. Case report should be informative and devoid of irrelevant details. Case report should have a clear message or learning point and this should be highlighted adequately. Rarity of the case does not mean it is suitable for publication. Written consent of the patient should be submitted together with the case report, especially when photographs are used.

References:

These should conform to the Vancouver style. The reference in the text should be numbered consecutively in Arabic numerals in parentheses in the same line of the text in the order in which they appear. The first five authors should be listed and if there are more than five, then the first three should be listed followed by *et al*. Examples are given below:

1. Kumar A, Patton DJ, Friedrich MG. The emerging clinical role of cardiovascular magnetic resonance imaging. *Canadian Journal of Cardiology*, 2010; **26**(6): 313-22.
2. Calenoff L, Rogers L. Esophageal complication of surgery and lifesaving procedures. In: Meyers M, Ghahremani G, eds. *Iatrogenic Gastrointestinal Complications*. New York: Springer, 1981: 23-63.

Website references too should conform to the defined Vancouver referencing format;

e.g.: Diabetes Australia. Diabetes globally [Internet]. Canberra ACT: Diabetes Australia; 2012 [updated 2012 Jun 15; cited 2019 Nov 5]. Available from: <http://www.diabetesaustralia.com.au/en/Understanding-Diabetes/Diabetes-Globally/>.

Units/Abbreviations:

Authors should follow the SI system of units (except for blood pressure which is expressed in mmHg). Authors should use abbreviations sparingly and they should be used consistently throughout the text.


Manuscripts that do not conform to these requirements will be returned for necessary modifications.

Manuscripts should be addressed to Chief Editors, Galle Medical Association, Teaching Hospital, Karapitiya and all soft copies should be sent to gmjgalle@gmail.com

Iodination - the need to enforce quality assurance

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Iodination of salt was made compulsory in Sri Lanka by the Food Act no 26 of 1980. After some delay the government decided to implement the iodination of salt in 1995.

The Medical Research Institute (MRI) helped by the WHO, has monitored the effects of iodination by conducting surveys on school children nationwide every five years (1 - 4) beginning from 2000-2001. The requirement of iodine (as iodate) at consumer level was brought down from 25 ppm at the beginning to 15 ppm in 2005, as surveys monitoring urinary iodine content in the sampled children, showed a median concentrations above the target level 100 µg/L.

They conclude after their most recent survey i.e. 2016, that the iodine content of salt packs available to the public are not 'Iodine content-wise' uniform throughout the different provinces of Sri Lanka. This was true between brands and within the same brand; an observation documented in each monitoring report in the last two decades (1-4). In consequence, this was responsible partially to the non-uniformity of urinary iodine content in the children of the different provinces. Fortunately, the urinary concentrations observed are all below the WHO recommended figures i.e. 300 µg/L. Paradoxical though it may sound, population demographics necessitates it to be so. I will explain.

As the intent was initially to prevent goitre, we need to review what's happened to the 'goitre-scape' since instituting iodination of salt, now almost two and a half decades ago. The data presented by the MRI on these surveys suggest, within the last two decades, the children who were the 'at risk' population to get goitre, have shown a regression of

both the prevalence of goitre and its size in all provinces; Uva province being the straggler. The surveys showed that in children (6 - 12 years) an overall (national) % incidence of grade 1 goitre has regressed from 18.2 to 1.5 and grade 2 goitre from 0.8 to 0.4 between 2000 (1) and 2016 (4) respectively, in consequence.

However, audits of patients attending surgical clinics in some formerly endemic districts have a slightly different picture (5). No doubt, they are older and selected, but need to be taken to account. Regression of nodular goitre prevalence in this older age groups began around seven years later and diffuse goitre thirteen years later. However the presenting grades (size) too, also showed regression.

These previously endemic districts, harboured an elderly population, especially females with multi-nodular goitres that have foci of autonomic activity. After iodination, the prevalence of hyperthyroidism (6, 7) has shown significant increase in all adult age groups with multi-nodular goiter, that too directly proportional to their age. So placing such elderly subjects at risk of cardiac fibrillation and consequent possible thrombo-embolism especially to the central nervous system (stroke), osteoporotic fractures etc. is not advisable.

The iodine content of salt packs, exceeding regulations has been shown to have increased the prevalence of autoimmune thyroiditis (AIT) (8, 9) leading to goitre (8) and hypothyroidism (which if gone undetected, with effects on the elderly, on pregnant patients and on the academic performance of schoolchildren). Less commonly hyperthyroidism can also occur.

A nationwide (except north and east) study done in 2007 - 2008 on individuals above the age of ten, revealed an AIT (clinical-serological-cytological) prevalence of 19-20% of individuals sampled (8) with the median urinary concentration being 235 µg/L. The Northern and North-Central Provinces have consistently shown the highest concentrations of urinary iodine (1-4, 9, 10) in both adults and children. Further, North Central province harboured the pocket with the highest prevalence of goitre (all age groups) in a study in 2007 (11). In a very recent study of AIT in the Northern Province, a high prevalence (approx. and 40%) of goitres having AIT, with its associated hormonal complications have been reported. Could AIT be also responsible for this increase in goitres? (12).

Salutary effects on the histological type of carcinoma of the thyroid (papillary type prevalence increasing as opposed to the anaplastic type) has certainly reduced morbidity and mortality of this scourge (13). Perusal of local Cancer Registry statistics reveal an increasing prevalence of papillary thyroid cancer, which though is less virulent and manageable has its own issues. Thyroid carcinoma, which was the fifth most common malignancy in this country among females in 2000 became the third in 2011 and the second most common in 2014 among females (14). A high prevalence of papillary thyroid cancer was found in Iceland and thought to be due to an excessive iodine intake (15).

This highlights the need to keep the urinary iodine content optimal, i.e. the iodine content of salt packs optimal, within prescribed limits throughout all provinces. The revelation that none of the salt manufacturer's had written instructions on the process of iodisation, i.e. the quantities that need to be added, is an alarming revelation (8). Besides details of manufacture, its packaging, storage must be supervised at the factory and retailer level. The consumer should be instructed regarding loss of iodine by washing or storage near a fireplace. At present, consideration is not given to the provinces with high dietary iodine like those in the dry zone. Has the time come for PHI of provincial councils together with the Sri Lanka Standards Institution, to act re-supervising factories, on the production, based on selective needs of the individual provinces? Iodine excess is in itself a health risk.

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The elusive parathyroids

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Introduction

The parathyroids are four small glands in the neck in close proximity to the thyroid gland and their main function is calcium homeostasis. Parathyroid disorders are common clinical entities encountered in practice. Primary hyperparathyroidism (PHPT) is by far the commonest disorder diagnosed in clinical practice. Worldwide studies show an annual incidence of PHPT of 20 cases per 100,000 people with an estimated prevalence in the general population of 0.5% to 1% increasing with age over 2% in both sexes by the age of 55 (1-3).

The precise incidence of parathyroid disorders in Sri Lanka is unknown and there is a noticeable paucity of literature on parathyroid disorders in Sri Lanka. Experienced clinicians have noted that in clinical practice; the diagnosis of PHPT is definitely less than figures quoted in the world literature. This appears to be a phenomenon seen in other Asian countries including India, China and the Middle East (3-5).

There are several reasons for this, perhaps we are not looking for it diligently or the disease pattern has changed from overt disease to asymptomatic disease as seen in the western countries or the diagnostic facilities especially in the government sector are inadequate for the diagnosis to be made accurately. It is likely that combinations of these factors are at play. It seems that the Parathyroid disease remains and elusive entity in clinical practice in Sri Lanka and in developing countries.

The need to diagnose and treat

In the western countries, wide-spread screening in the 1970s increased the diagnosis of PHPT

especially the asymptomatic disease dramatically (6). Hence the asymptomatic patients and the patients with mild symptoms became the predominant clinical patterns in those countries. The picture in Asia remains undetermined, yet in India the picture is same as before with a significant number of patients having overt disease (3).

Around 85 - 90% of PHPT is due to a single adenoma and surgery is curative and relieves symptoms even if they are mild and non-specific such as fatigue; and this recovery is early in the postoperative period (7-9). If a Patient has overt symptoms they are likely to be referred for surgery. The issue is with patients who are asymptomatic or have only mild nonspecific symptoms. The experience is that PHPT and other parathyroid diseases are not detected in the age group as it should be done at a point of time when they can be prevented from having a long-term morbidity and the very rare occurrence of mortality. Even if surgery is not undertaken or is not recommended; medical management with targeted medical therapy using amino-bisphosphonates for skeletal protection and cinacalcet for lowering serum calcium needs to be considered. This requires accurate diagnosis initially. This means that even a selective screening policy must be employed in Sri Lanka and in other developing countries. This raises the question of who should be offered screening. There are some obvious candidates for screening. They include:

- Patients with recurrent, multiple or bilateral urinary calculi
- Patients with recurrent acute pancreatitis
- Patients over 50 years with persistent bone pain without an obvious cause

- Elderly patients with unexplained fatigue and neuropsychological symptoms

These patients will need the accurate assessment of serum ionized calcium levels. Ideally at least 2 levels if the results are marginal. If they have proven hypercalcaemia and without evidence of an underlying malignancy, they should have a serum parathormone assay (PTH).

Urolithiasis is the original and the commonest manifestation in PHPT. It is not uncommon to come across patients with multiple bilateral or recurrent urinary tract calculi who have not had an assessment of their calcium status. This may be due to many factors including non-availability of facilities, but it is likely that some of these patients are having PHPT. Several studies have shown that about 5% of patients with urolithiasis have PHPT (10-12).

There is very little doubt that screening for PHPT and treating it prevents significant morbidity and mortality hence all attempts must be made to 'capture' the elusive parathyroid and treat it. There are several guidelines (13) that will help in easy decision making. Every effort must be made to detect and treat parathyroid disease particularly PHPT.


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Why is COVID-19 killing more African Americans than Whites in the United States?

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ABSTRACT

A social gradient in mortality and morbidity exists within countries owing to structural inequalities. Disease and health are not neutral to social, political, and economic relations, but they interact, and the human body is the stage on which these social contradictions are played out.

Keywords: *African Americans, COVID-19, health disparities, institutionalized racism.*

Introduction

Across the United States, African Americans are disproportionately affected by the COVID-19 pandemic. As of May 1, 2020, according to the official website of U.S. Centers for Disease Control and Prevention (CDC), the total number of reported COVID-19 cases had surpassed one million, while the total number of deaths had reached 63,000. Of these nationwide cases for which race were identified, 30 percent were African Americans, despite the fact that they represent only 13 percent (43 million) of Americans. In some states, such as Mississippi, Georgia, Louisiana, and Alabama, over 50 percent of reported cases were African Americans (1). The large number of deaths has overwhelmed African American communities across the United States. The disease is still spreading, and by the time the infection is brought under control these figures could be much higher. This review is a critical reflection on the current crisis of COVID-19 in North America, and its impact on African Americans across the United States.

COVID-19 preying on the vulnerable

In the United States, there is a saying: “when Americans sneeze, African Americans catch pneumonia.” There is a truth to this adage: it has been shown over and over again that African Americans are the least healthy segment of the US population. To understand the overwhelming health disadvantage of African Americans, it is critically important to understand the historical context of the African American population in which the social determinants of health have been shaped, and continue to be shaped. As a racial minority, they have experienced institutionalized racism since the time of slavery, and institutionalized racism, discrimination, and social injustice persist to date in almost all spheres of their lives that foster toxic physiological stress (2). The African American health disadvantage is a reflection of these various structural inequalities that have endured (3). For any measure of health, African Americans fare poorly compared to white Americans (4). It has been known for decades that African Americans have significantly lower life expectancy at birth (75 years), compared to white Americans (79 years). Infant mortality is 11.3 for African

Americans, compared to 4.9 for white Americans, per 1,000 live births. For maternal mortality, according to the National Center for Health Statistics, African American mothers fared the worst, dying 2.5 times more often than white American mothers (37.1 vs. 14.7 deaths per 100,000 live births). African Americans have worse outcomes than white Americans for almost all cancers at every stage of the disease (5). African Americans suffer disproportionately from cardiovascular diseases, hypertension, diabetes, asthma, and obesity.

The COVID-19 pandemic has exposed that, as in any catastrophe, it is those who live on the margins of society who suffer the most. Low-income communities with high rates of unemployment, overcrowded and substandard housing and a long-standing history of institutionalized racism have experienced the highest rate of infection and death from COVID-19 in many countries. Many of these communities also have the highest number of individuals with metabolic diseases and other debilitating illnesses, which have left them less able to fight any new infection on their own. The pandemic has brought to light, among other things, the existing deep-seated structural disparities along race and class lines. Yet, the public discourse and the mainstream media “sanitize” these social ills with carefully crafted language emphasizing the pathophysiology of the infected individuals, thus glossing over social reality. For example, those who have been disproportionately affected by COVID-19 are often referred to, as people with “preexisting conditions,” in the language of the medical insurance industry in the United States. These “preexisting conditions” are invariably clinical conditions, such as diabetes, hypertension, obesity, asthma, and suppressed immune systems, even though these preexisting medical disorders are generally preceded by certain social structural disorders. By naming them merely as “preexisting medical conditions” we lay the blame at the feet of individuals and fail to question the structural social injustices that engender these problems in the first place. When do existing social structural conditions become “preexisting medical conditions”? Why do we refer to illnesses as “preexisting conditions,” instead of referring to their underlying socio-economic causes? Could the pandemic of COVID-19 be an opportunity to redress the existing socio-economic inequalities and social injustices?

In population health, researchers have observed an inverse correlation between socio-economic status and mortality. It has been well documented that even in countries with universal access to healthcare, there is a socio-economic gradient in morbidity and mortality, which points to the evidence that there are factors in the socio-economic systems that affect health. Although this social gradient in health exists in all societies, it is particularly acute in societies with wider socio-economic disparities reinforced by powerful ideologies such as race, gender, class, and caste. In affluent societies, it is not one’s absolute income that affects health and illness; rather, it is one’s relative income that is crucially important for health. The countries with similar income levels, but relatively lower level of income inequality, have lower morbidity and mortality rates compared to those with greater income inequalities. This particular trend in income vis-à-vis mortality and morbidity rates has led researchers to explore more closely the importance of social status, social cohesiveness, and structural social inequalities for people’s sense of belonging, mutual respect and the overall health and psychological well-being. These studies found that after a certain income threshold that fulfill the needs of a basic standard of living of the population, which includes adequate nutrition, running water, indoor toilets, etc., further increases in income, or level of national wealth is less accounted for in overall health. Most importantly, it is at this income threshold that developed and some developing societies undergo an epidemiological transition from predominantly infectious diseases to chronic diseases as the major causes of death. Further, at this point in the economic development of a nation, mortality and morbidity rates become more sensitive to relative income and the overall quality of life, rather than to absolute income. The income disparities affect social relations and social cohesiveness, which manifest as a social gradient in morbidity and mortality. Simply put, people in the lower social echelons perceive their place in society not exclusively in terms of the material wealth but in terms of nonmaterial qualitative status. It becomes an obstacle to their self-realization and autonomy, and a powerful stressor that activates neuroendocrine and immune responses (6).

Health impact of socio-economic disparities and institutionalized racism

While their socio-economic position is a critically important factor in the African Americans' health disadvantages, it alone cannot fully account for them. These disadvantages persist even when controlling for income and education. Researchers have explained this trend in terms of chronic stress engendered by the hostilities of a racist and sexist social environment: "persistent racial differences in health may be influenced by the stress of living in a race-conscious society. These effects may be felt particularly by black women because of 'double jeopardy' of gender and racial discrimination." (7). Hostility is known to engender anger, anxiety, and depression, which in turn give rise to coronary heart diseases via neuroendocrine and physiological pathways. Epidemiological research defines hostility as a longstanding attitudinal temperament that tends to influence social interactions, which can be damaging to one's health depending on the intensity and the length of interaction. For people who live in such an environment, it's a lifetime of distress. Numerous studies have shown how fundamental social institutions such as healthcare treat African Americans. A study conducted in 2002 titled *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*, published by the National Academy of Sciences, found some shocking evidence of racial bias against African Americans in healthcare settings. The report found that African Americans are less likely to receive appropriate cardiac medications; to undergo coronary bypass surgery; to receive less often necessary kidney dialysis and transplants than whites. This often results in higher death rates among African Americans. They are 3.6 times more likely to have legs and feet amputated than whites resulting from diabetes, even when all other factors were equal. The report also found that cesarean sections were 40 percent more likely to be performed on African American women compared to white women (8).

For a vast majority of African Americans, everyday life is an extremely stressful experience owing to institutionalized racism, which reflects on their health status. Stress induced disease, or *allostatic load*, is the chronic wear and tear on the body resulting from adaptation to a stressor. One of the

common outcomes of the adaptation (*allostasis*) is cardiovascular reactivity resulting in high blood pressure. A chronically elevated blood pressure accompanies several risk factors such as increased blood levels of glucose, low-density lipoprotein, and cholesterol, which are all known clinical risk factors for heart diseases, diabetes, obesity, and strokes. Studies have shown that once the neuroendocrine process raises the blood pressure, and maintains it at a high level for an extended period, blood pressure tends to remain high even if the initial cause of the elevation no longer exists. The brain and arteries develop structural and functional remodelling as part of the adaptation. This remodelling, over time, particularly in connection with arterial constriction, causes damage in the inner lumen of the arterial walls, where atherosclerotic plaques begin to develop, obstructing the blood flow. At this stage, the narrowed arteries with blockages are bound to cause heart attacks and strokes (9). Among the major causes of death and the life expectancy disadvantage for African Americans compared to white Americans are ischaemic heart disease, cerebrovascular disease, and hypertension. For African American women who experience institutionalized racism and sexism along intersectional lines, their health implications are further evidence in the higher rate of infant and maternal deaths due to hypertension and pre-eclampsia.

Further, under chronic stress, the release of glucocorticoids undermines the production of white blood cells, which has several pathological consequences. During prolonged stress, the suppressed immune system delays the healing of wounds and injuries, and most importantly exposes the organism to various pathogenic agents such as viruses, bacteria, and carcinogenic agents, which are normally removed from the body by the white blood cells. The immune system, particularly the thymus gland and its ability to produce white blood cells, is mediated by glucocorticoids (10). This explains the cruel truth that people with suppressed immune systems are most likely to catch COVID-19, and the typical neuroendocrine and physiological reactions of those living in toxic social environments seem to fit this epidemiological description. The prolonged immune suppression caused by the chronic stress means that individuals may not be able to fight infections, including cancer.

Likewise, under chronic stress, glucocorticoids impede the insulin function that regulates the blood glucose level. The function of insulin is to remove the extra glucose from the blood and store them in the muscles, body fat, and the liver as *glycogen* to be utilized when the blood glucose level goes down. During stress, the increased demand for energy to meet an external challenge prevents this insulin activity resulting in abnormally high levels of blood glucose. While elevating blood levels of glucose and free fatty acids, and preventing insulin from storing them in the muscles and the liver, the glucocorticoids promotes the deposition of glycogen in the abdomen. It has been identified that abdominal obesity, as in Cushing's disease, as well as type I and type II diabetes are triggered by chronic stress (11). Recent epidemiological studies have substantiated these observations that excessive metabolic disorders among African Americans are related to the psychosocial stress of living environment. They have shown that structural inequality is *positively* correlated with obesity rates, diabetes-related mortality rates, and a person's average daily calories intake (12).

Given this general state of health, it is hardly a coincidence that a large percentage of African Americans have become victims to the COVID-19 pandemic.

Conclusions

The COVID-19 pandemic has overwhelmingly affected the African American population in the United States, but the link between deep-seated social structural conditions and the rapid spread of the pandemic suggests that diseases transmit easily in communities in which the human host is left vulnerable. This particular scenario is not, of course, unique to the United States, but it is all the more interesting and important because the United States is the richest country in the world, and its professed ideology of "equality of opportunity" has been a magnet for millions of new immigrants each year from around the world. Structural inequality, racism, sexism, and all forms of discriminations exist around the world, and these existing social and economic conditions make people susceptible to diseases, rather than the other way around.

Diseases are often symptomatic of a much deeper social malaise, but powerful ideologies prevent people from understanding this reality; particularly the American corporate media, the billionaire-class, and the political elite are oblivious to the impact of structural inequality, and rarely look inwardly to see the true causes of America's health disparities. The presence of the COVID-19 pandemic in the United States highlights these inherent inequalities in American society yet again. Let us hope that this time it may be a catalyst for fundamental structural changes in the future.

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Ethical dilemmas in pandemics - lessons from COVID -19

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Introduction

At the end of December 2019, the Chinese government sent out a public alert that a “pneumonia of unknown cause” had been identified in the city of Wuhan. Soon after, the causative organism was identified to be a novel coronavirus and named SARS-CoV-2 as the infection, COVID-19 (1). Since then, the infection has rapidly spread throughout China and reached multiple continents over a few weeks and was officially declared a pandemic by the World Health Organisation (2). The outbreak of COVID-19 has imposed a substantial health burden globally creating an international public health emergency.

With the world economy in a tailspin, financial market indices cratering, and international travel and unfettered movement of humans and goods severely disrupted, many nations have been exposed for a lack of preparedness for a global pandemic of this magnitude. This crisis has tested emergency services in every country, leaving bare the shortcomings of health systems including those in the wealthy industrialised nations. Compounding this is a devastating impact on the livelihood of vulnerable sections of society that has left governments scrambling for bailout packages for their people. Adding to it is fear and helplessness in people on a scale not seen previously except during natural disasters and genocidal wars.

The COVID-19, in comparison with other coronavirus infections like SARS (Severe Acute

Respiratory Syndrome) and MERS (Middle East Respiratory Syndrome), is a more contagious but a less deadly disease (3). Risk is enhanced for the elderly and those with serious underlying medical conditions, although the young and the previously healthy are not totally immune. Spread is mainly through respiratory droplets while other modes of transmission have been reported (4).

The transmissibility depends on the biological properties of the coronavirus and contact patterns which may reduce with public health intervention. There are reports that spread may occur during the incubation period before symptoms emerge, justifying some early aggressive preventive measures (5).

The tried and tested public health measures that have been implemented during infectious outbreaks of this nature are isolation, quarantine and social distancing. These measures aim at limiting social interaction and physical distancing to prevent the infection from spreading further. The support for such public health interventions are not uniform; some consider this insufficient while others oppose it severely as it restricts free movement.

When such threats emerge, a wide range of legal avenues are exercised under public health laws and emergency statutes. Closure or restricted use of public spaces, shuttering of business premises, restricting hours of trade, discontinuation of work, enforcing *cordon sanitaire*, curfews, price control and travel restrictions are some of the available legal powers.

This paper examines the ethical challenges and dilemmas posed by public health actions, research initiatives and healthcare worker vulnerability. Additionally, we will explore how these dilemmas can be managed in a way that respects ethical norms, constitutional safeguards and democratic values.

Public health actions

Public health is critically about population health, protecting or improving the health of everyone in a society or entire population with actions for the greatest good for the greatest number. It is the first and the quickest mode of action that can be deployed to interrupt transmission chains during infectious outbreaks: isolating the infected and treating the sickest and distancing the others from each other.

Public health actions such as vaccination in non-urgent situations have generally taken place through voluntary cooperation of individuals or community than on compulsion. Many measures that are taken are without dispute and are deemed necessary and uncontroversial such as isolation of a confirmed case in a hospital or healthcare facility with adequate safeguards for further spread of the infection.

During the efforts to contain the spread of the infection effectively, the values that the society holds dear should not be a casualty and existing injustices should not worsen. Values imbue all areas and levels of public health theory and practice and are culturally bound. The key Siracusa Principles, adopted by the UN Economic and Social Council in 1984 recommends that restrictions should, at a minimum, be among others be least intrusive and restrictive available to reach the objective, be based on scientific evidence and neither arbitrary nor discriminatory in application of limited duration, respectful of human dignity, and subject to review (6).

In these crisis situations, it is inevitable that individual human rights and civil liberties will be restricted for the greater good of the public. However, the limits placed on individual rights should be essential, proportionate, non-discriminatory, just and in full compliance with national and international laws. The local laws and cultural context will nevertheless influence some of these actions. Vulnerable groups need to be

protected during these times: the disabled, elderly, migrants, asylum seekers, homeless and prisoners.

Sanctity of life

A pandemic is a time when the sanctity of human life is tested, as resources dwindle, and brutal utilitarian ideas prevail. With every passing day, state powers expand, authorities overreach, and individual rights squeezed in a frantic effort to contain the spread. It is understandable that governments blinded by many unknown factors need flexibility to act decisively. However, the society expects it to act for the common good with fairness and proportionately.

Individual human rights of liberty and privacy are a luxury and often a casualty in times of such exigencies. Reports from different parts of the world indicate several human rights violations including freedom of expression, censorship, discrimination, arbitrary detention, and xenophobia during this pandemic (7).

Surveillance

Public health surveillance is a crucial arm of a suite of countermeasures that are employed in the early part of an infectious outbreak. The data that is gathered provides the scientific basis to understand the transmission of the infection and provide early warnings to plan a targeted response.

Legally, public health law may allow for the collection of sensitive information related to personal health, travel and contacts particularly at the beginning of outbreaks (8). When these data are collected in the interest of protecting a broader public, people cannot expect the same level of personal health privacy that is operative during clinical encounters. However, it is expected that authorities keep the information confidential and process it anonymously and limit it to the period of the crisis. A breach of this right may cause social and psychological harm. Disclosing information publicly that allows indirect identification of individuals or sharing it with others not entitled to have it, are serious breaches of privacy.

There is justification to forego informed consent procedures when it can be shown that the collected data is useful for accurate portrayal of spread and

beneficial to protect the vulnerable population (9). Legitimate authorities should be involved in the collection of data and it should be limited to the infection under study.

Governments around the world are using location information to track citizens to identify travel patterns and alerting users to locations where infection has been detected. Cell phone carriers in several European countries shared customers' locations with their respective governments to track the spread of the virus and success of containment methods (10). Some countries required citizens to install software on their smart phones which predicts people's health status, tracked their location and movements while others had their data in the public domain where people with COVID-19 had previously visited (11).

The extensive technological use is novel in pandemics, beneficial in the battle for containment of the spread of the infection but brings out new challenges. Under the public health emergency, authorities seeking such information in many countries may not need any judicial permission. The concern is about the abuse of these digital forays when the pandemic is over, as governments will be reluctant to dismantle these intrusive surveillance methods and continue well into the post-pandemic phase. The aggregated and anonymised data that is available should be less granular with additional measures put in place to protect the personal data of infected and those at risk.

Quarantine, isolation and social distancing

Isolation and quarantine are the two public health actions that illustrate the most extreme of state powers: the power to deprive the individual of free movement and existing liberties.

Dating back to as early as the fourteenth century, quarantine has been used as an important strategy in the containment of contagious diseases (12). It is described as means to restrict the movement and activities of asymptomatic people who have had exposure to an infectious disease, usually for the incubation period of the suspected pathogen. Quarantine aims to achieve two important goals - to stop the disease transmission within a community and to help with identifying individuals under surveillance for medical care.

Social or physical distancing, in contrast to quarantine measures is aimed at limiting the physical interactions between individuals of a community. This involves increasing the physical space between individuals by ensuring a safe distance of at least six feet. Both measures aim to limit disease transmission as common goals (13).

Social or physical distancing is highly disruptive to daily life and felt heavily by the vulnerable and economically disadvantaged sections of society. With risk of contracting the infection disproportionate, a low-risk healthy young person rides it out by staying at home at great personal cost while the benefits accrue to the most vulnerable sections of society. Chronic social isolation is not without its adverse effects and when prolonged can increase the risk of a number of health problems including death (14). Closures of schools, universities and workplaces push students, employees and parents to stay and work from home. If implemented fairly and shown to be effective to slow the transmission through scientific studies as shown in the current COVID-19 outbreak in China, public adherence to the measures are more likely (15).

In some countries, reports are emerging of coercive and at times heavy handed methods enforced by security authorities to control the population and groups. When the population appears to be untrustworthy of following quarantining or physical distancing measures, curfews have been imposed sometimes at short notice. Such arbitrary enforcement violates the rule of least infringement of human rights.

An ideal solution for nations as part of epidemic preparedness, draft and follow proper quarantine policies in a transparent manner with wide consultation. When done with adequate planning, not only will the standards for ethical principles be met but there would be a higher likelihood of public acceptance for such a policy.

Stigmatisation and shaming

Stigmatisation is an unfortunate consequence of infectious diseases. In the past, tuberculosis, syphilis and more recently HIV infection were notorious examples. Shaming is another weapon used for

rule-breakers but offers a prospect of reintegration to society that stigmatization does not (16). Some justify these strategies in chronic negative behaviours such as smoking to dissuade from such practices (16). Others view it as paternalism and an affront to the liberties and rights of the individual. It would indeed be an uneasy act to include in the repertoire of public health measures regardless of whether the goal was to protect people from harming others or themselves.

These unfortunate practices are further compounded when the media picks up the story and the location of individuals is divulged leaving the person to be publicly identified, criticised and humiliated. In some instances, names and photographs have been posted in newspapers and websites similar to the pursuit of a suspected criminal.

Healthcare worker hazards and rights

With their avowed commitment to care for the sick and injured, doctors and other healthcare workers have an obligation to provide urgent medical care during health emergencies. The standard risks are implicit in the nature of the job and in the ethical practice of medicine. There is significant risk of infecting themselves and of death as seen among healthcare workers during the Ebola, SARS, MERS and in the current COVID-19 pandemic (17,18).

It is reasonable to expect, that the frontline health staff receive sufficient protection from being exposed to hazards that put them at risk of infection. Reports of insufficient and inadequate personal protective equipment (PPE) to frontline health workers during patient encounters with confirmed or suspected cases have raised concerns during this crisis with conflicting and confusing guidelines issued by authorities about when these protective measures should be used (19). With supplies dwindling in many countries, these scarce resources have been limited to high-risk procedures and forced to reuse single-use items of PPE have also raised alarms among the healthcare workers.

An obligation of the state and health care institutions exists to safeguard the rights and safety of healthcare workers as they are irreplaceable. It begins with good planning of adequate medical supplies and staffing to ensure a safe work environment.

Resource allocation

Other contentious areas in managing COVID-19 patients involve identifying patients for ventilation and resuscitation. When a hospital does not have enough staff or equipment to provide ventilatory support, priority is assigned to patients with the greatest likelihood of benefit from it. The ethical rationale for such an approach is a strictly utilitarian one. Excluding certain patient categories such as those with severe lung disease or cognitive impairment may appear reasonable but ethically problematic. A fair and consistent way to deal in such situations as practised in some US hospitals is to use a score-based framework (using multiple criteria) which includes all morally relevant values into an objective decision-making process (20).

At times of crisis, as seen in this pandemic and in disaster situations, hospitals would relocate its usual facilities, staff and equipment to prioritise emergent needs. As a result, elective surgery and nonurgent investigations will be deferred, staff reassigned to other units and supplies deployed to where it is needed most. When these are done ad hoc without previous planning or clear communication it usually leads to tensions and discontent among the stakeholders.

The dilemmas that occur on the ground need to be resolved invoking all the principles of ethics including beneficence/non-maleficence, professional integrity, utility and justice to balance the benefits to the patient and harm to the caring team.

These difficult decisions taken under unusual demands on resources affecting the sanctity of life leads to moral injury to health workers. In the aftermath, as observed in other epidemics, burnout, psychological stress and anxiety is likely to be present among the healthcare staff (21).

Duty and law

In carrying out duties, the healthcare worker needs to comply with the law of the land. Countries and states may invoke additional powers beyond those in the regular public health laws and promulgate new ones to deal with the imminent threat. Matters of notification, disposal of dead bodies are examples of inflexible duties as it allows little or no discretion

in their application (8). This puts the worker in moral conflict with respect to non-discrimination, and human rights. Such disputes should be solved through community engagement and mediation. When laws governing public health matters are reviewed in the future, the idea that much of the work of public health action is about risk assessment should be recognised (8).

Public health emergency research

The key to proper public health policy in infections is knowing the science behind transmission. Research through innovative therapies and vaccine technology will ultimately provide lasting solutions to combat this viral infection.

The need to conduct research during epidemics such as in COVID-19 is undisputed and urgent. Some see it as an ethical obligation to conduct research during the epidemic while others are concerned that it may draw efforts away from providing clinical care. In the absence of an effective therapeutic agent for COVID-19 infection, the immediate need is to embark on safe and effective interventions.

Significant ethical issues emerge when untested therapies are used without its clinical effectiveness established in clinical trials. In desperation, drugs used in similar viral infections and other conditions are repurposed based on experimental evidence at best. Hydroxychloroquine is one such example for its easy availability and low cost.

Undoubtedly, randomized controlled clinical trials sit on the pinnacle of the level of evidence when it comes to establishing the effectiveness of a treatment, device, or other intervention. Although flexibility of clinical trial designs is justifiable due to the urgency, the scientific validity and ethical integrity should not be sacrificed in pursuit of new therapeutic modalities.

Valuable lessons have been learnt in conducting research during the most recent Ebola outbreak in West Africa in late 2013 despite the therapeutic trials failing to achieve efficacy endpoints. The expert committee in charge of the research identified seven moral requirements that should guide all clinical research including research conducted during epidemics: scientific and social value, respect for persons, community engagement, concern for

participant welfare and interests, a favourable risk - benefit balance, justice in the distribution of benefits and burdens, and post-trial access (22).

Providing protective immunity through vaccination is undoubtedly the most effective strategy to prevent and control this infection in the long term. At the best of times, human vaccine development involves careful study design, lengthy and stepped sequence of testing and ethical oversight. Prior to an outbreak, there is no way of knowing the strain of the organism for conducting vaccine studies beforehand. The dilemma is further compounded due to strict adherence to international guidelines on human clinical trials.

In the rush to test an experimental vaccine, new approaches are adopted where the traditional steps of prior animal testing are abandoned before human experimentation. Human challenge trials, which sidestep early safety testing (Phase 3) of standard trials, is proposed to cut waiting time for vaccine efficacy (23). Significant ethical issues are raised as no effective treatment is yet available for any volunteers who may develop severe infection from the live virus. Limiting the risk by recruiting young healthy volunteers, providing excellent aftercare and close monitoring of subjects in high level medical facilities minimises the risk but does not eliminate the occurrence of unforeseen complications. Although these approaches gain valuable time, it is unlikely an effective vaccine for coronavirus will be available during this epidemic.

A robust peer-review of the research proposal can be undertaken to offset some of these constraints. Another approach is to adopt a “core protocol,” model, which would allow a single clinical trial to extend across multiple infectious disease outbreaks (24). This approach is to avoid publishing data from studies that have not reached their pre-specified outcomes due to waning of the epidemic. The data would be stored, rather than reported, and the trial would continue the next time another outbreak appears.

Conclusions

Global health realities have exposed ethical transgressions, social inequalities and healthcare vulnerabilities by this contagion. In a globalized

world, the threats from novel pathogens crossing national boundaries require a new world order of cooperation and solidarity of international health, sadly missing at the start of this crisis. Preparedness for emerging diseases should include rigorous consideration of ethical issues in advance of future outbreaks to maintain public trust and safeguard the population health.

The crises should not be used to erode civil liberties. Restrictions of rights and freedom should have a legal basis and not be arbitrary or discriminatory. Exploring less intrusive evidence-based alternatives will make public health actions less controversial and more acceptable. Good public health that respects civil liberties will enhance public health action. Hopefully, lessons learnt from this pandemic will create a renewed urgency for better preparedness.

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Bone strength beyond bone mass

The Galle Medical Association Oration 2019

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Introduction

Fragility hip fracture, a serious manifestation of osteoporosis in the elderly, is a worldwide problem associated with low bone strength. With the increasing elderly population, incidence of hip fracture is estimated to be increased - especially in Asian countries (1). Low bone mass has been recognised as the strongest risk factor for fragility fracture. However, studies have reported the limitations of assessing bone strength or fracture risk based on bone mass measurements alone (2, 3). The ability of a bone to resist fracture, or whole bone strength, depends not only on the bone mass, but also on bone size, shape, spatial distribution of bone mass, bone geometry, cortical and trabecular microarchitecture and the balance between bone formation and bone resorption (4). Therefore, the study of factors associated with geometric adaptations and biomechanical behaviours of the hip, as a compensatory mechanism for enhancing bone strength against low bone mass and hip fracture risk is important.

Bone undergoes formation and resorption that are coupled processes and during growing ages bone formation predominates, leading to an increase in bone mass till it reaches the peak bone mass (PBM). PBM is an important determinant of bone strength, aiming fracture prevention in old age because 50% of bone mass at age 70 is estimated to be predicted by PBM (5). Theoretical analyses further estimate that a 10% increase in PBM could delay the development of osteoporosis by 13 years. Physical activity (PA) is recognised as one of the strategies to optimize skeletal development in growing children.

The pre- and early peri-pubertal period, a period with fast skeletal growth, is considered as a window of opportunity to enhance bone strength by physical exercises (6). However, most exercise interventions in children have predominantly been focused on volunteers, with specifically designed high-impact exercise intervention programs or organised sports activities using competitive athletics (6). Therefore, when we plan to design an exercise program as a preventive strategy against low bone strength, it should come from a population-based level where every child could enjoy in a safe environment. With sophisticated lifestyles and the development of modern technology, physical inactivities and sedentary lifestyle have become increasingly prevalent in modern societies. As a result, non-communicable diseases and childhood obesity have been recognised as growing global health concerns. Meanwhile children and adolescents in Sri Lanka have also moved away from the playground, or active lifestyle. Physical inactivity is identified as one of the most prominent risk factors for both low bone strength and childhood obesity.

Anthropometric parameters such as height, weight and body mass index (BMI) are important practising growth indicators to assess the adequacy of growth. The Pediatric Official Positions of the International Society for Clinical Densitometry (ISCD) 2007 revealed the requirement of age and sex specific normative data in children and adolescents including the anthropometry, body composition, and bone measurements of multiple skeletal regions along with their relationships when evaluating growth disturbances (7).

Among the development of different bones, the development of femoral neck (FN) geometry is of crucial importance to increase bone strength as a fracture prevention strategy in elderly. However, the lack of published data regarding age and sex specific geometric adaptations at hip emphasizes the importance of studying FN geometry. FN connects the femoral head to the shaft. The narrowest FN represents the smallest periosteal diameter (PD) and is identified as the weakest point. This narrowest neck is used as the region of interest when determining the geometric indices and biomechanical measures of the FN. Using the facts described above, Thomas. J. Beck, an American scientist, designed a cost effective dual energy X-ray absorptiometry (DXA) based advanced hip structural analysis (HSA) technique, with minimum radiation exposure, to estimate the geometry and biomechanical strength of the proximal femur (8).

Based on this background, the study series presented in the oration was planned in two phases, and the overall aim of this work is to improve bone strength, aiming future fracture prevention.

Phase I: Physical education exercise intervention

- The main objective of this study was to evaluate whether a general school-curriculum based moderately intense physical education intervention, where every child could participate, leads to improved accrual of bone mass, bone size and FN structure in a group of pre-pubertal children.

Phase II: Three cross-sectional studies

- **Study I** evaluated the age and gender specific changes in the normative anthropometric, body composition and bone growth measurements in children and adolescents to evaluate the timing and magnitude of accrual of bone mineral and bone size in different skeletal regions.
- **Study II** evaluated the age and gender specific normative FN geometry and biomechanical estimates of FN and estimated whether changes in geometric adaptations and biomechanical behaviours at FN during growth counteracted the age related loss of bone mass in elderly as a fracture preventive strategy.

- **Study III** evaluated the relationships of anthropometry and body composition on FN geometry in children and adolescents.

Methods

In this oration, I wish to present the findings of a research project known as “paediatric osteoporosis prevention (POP) study”, which was conducted in Malmö, Lund University, Sweden. In this study series, More than 99% of participants were Caucasians and none were on lifestyle restrictions or had diseases or medications known to affect growth or bone metabolism. An interviewer-administered questionnaire was used to evaluate life-style factors such as nutritional habits, level of PA, smoking, alcohol, and diseases and medications. The questionnaires of younger children were assessed together with the parents or guardians. Pubertal status was assessed using Tanner staging. All the studies were approved by the Ethics Committee of Lund University and the Radiographic Committee at Malmo University Hospital, Malmo, Sweden and were conducted according to the Helsinki Declaration. Informed written consent was obtained from parents or guardians of participants and the study participants before starting the study. Statistical calculations were performed using Statistica version Statistica®, version 6.1 (StatWin®) and a p-value of <0.05 was considered as a statistically significant difference.

Phase I: Physical education intervention

Study design and study participants: For the intervention study, four schools within similar socioeconomic backgrounds were selected. One school, which was geographically away from the other three, was invited to participate as the intervention school and the other three schools participated as control schools. The intervention included moderately intense physical activities within the general Swedish physical education (PE) school curriculum. For the intervention, just the duration of PE classes was increased without changing any activities within the school curriculum. The duration of PE was increased from 60 minutes or 1 - 2 lessons per week, to 200 minutes per week. That is, 40 minutes per each school day. The PE curriculum includes a variety of

free activities, such as ball games, running, jumping and climbing under the supervision of the ordinary class teacher.

At baseline, 54 girls in the intervention and 64 in the control group participated. Forty-nine girls in the intervention and 50 in the control group participated at the two-year follow-up. A sample of 84 boys in the intervention and 68 in the control group participated at baseline. Eighty boys in the intervention and 57 in the control group participated at the two-year follow-up.

All measurements (level of PA, anthropometry and bone measurements) were taken at baseline, before the intervention, and at one year and at two-year follow-ups. In the PE intervention, absolute annual changes in bone mass and bone structure were calculated as changes per 365 days and were compared between the intervention and the control group at one year and two year follow-ups by student's t-test between means.

Anthropometric measurements: Body weight was measured with an electric scale to the nearest 0.1 kg and body height by a wall-tapered height meter to the nearest 0.5 cm. BMI was calculated as weight in kilograms divided by height in meters squared.

Body composition and bone measurements: Fat mass and lean mass were evaluated from the total body (TB) scan in TB, arms and legs using DXA scan (DXA, DPX-L version 1.3z, Lunar®, Madison, WI). Bone mineral content (BMC) and bone mineral density (BMD) were evaluated for the TB (including head), arms, legs and total spine by a TB scan; femoral neck (FN) by a hip scan; and third lumbar vertebra (L3) and second to fourth lumbar vertebrae (L2–L4) by a lumbar spine (LS) scan. The width of the L3 was estimated from the LS scans and the width of the FN was estimated from the hip scans. Pediatric software was used in children below 35 kg in weight and in all other participants, adult standard software was used. The measurements were done according to the standard procedure with the participants dressed in light clothes.

The following hip geometry and biomechanical indices, namely, FN width (FNW, cm), cross-sectional area (CSA, cm²), cross-sectional moment of inertia (CSMI, cm⁴), section modulus (Z, cm³),

BMC and BMD, at the narrowest FN, were evaluated by HSA software (Lunar DPX-L 4.7E). In addition, endosteal diameter (ED, cm) was estimated using the algorithm reported in the literature (9). Mean cortical thickness (CT, cm) was calculated as the difference between PD and ED, divided by two.

Assessment of the level of PA: Subjective level of PA and lifestyle factors were assessed using an interviewer administered questionnaire. Objective level of PA was assessed using the MTI accelerometer, model 7164 (Manufacturing Technology Incorporated, Fort Walton Beach, FL, USA).

Results of the exercise intervention: At baseline, in both girls and boys, the two groups did not differ with regard to lifestyle factors, age, anthropometrics or bone parameters. When the annual changes were compared, both boys and girls in the intervention group had significantly higher accrual of BMC and larger gain in bone size in the lumbar vertebrae. No differences between intervention and control groups were observed for annual changes in the FN bone mineral accrual or FN geometry and biomechanical changes measured at one year and two-year follow-up. The positive effects in the lumbar spine were less in boys than in girls (10). All skeletal responses compared to controls in percentage gain at one year and two year follow-ups are summarised in Table 1.

The larger proportion of trabecular bone in lumbar vertebrae than in FN could partly explain the discrepancy, as skeletal response to mechanical load is more marked in trabecular regions than in cortical regions due to the larger surface-to-volume ratio in trabecular bone. In addition, girls of the same chronological age are generally closer to puberty than boys of the same age. It is also widely accepted that the skeleton produces a greater response to mechanical load in the early pubertal period. Because of the earlier onset of puberty, girls reach peak BMC velocity roughly 1.5 years earlier than boys.

The findings that LS bone mass increases initially more in girls than in boys of the same chronological age is consistent with literature from children and adolescents from a similar background. The finding is of considerable interest as high-intensity activities with few daily repetitions are more important than a long duration of exercise if the purpose is to reach skeletal benefits (5). Accelerometer data further revealed that all of these children were physically active and reached the international recommended level of PA, which is more than 60 minutes of MVPA per day (Table 2).

Based on these findings the following conclusions were made. The increased duration of physical activity within the school PE curriculum was associated with beneficial accrual of bone mass and bone size in the LS but not in the FN. All the children in this study were physically active. None significant results at FN need to be studied in future studies. The findings of this study were published in SCI cited journals (11-14).

Table 1: The summary of skeletal responses compared to controls (percentage) at one year and two year follow-ups. *P<0.05, **P<0.01, ***P<0.001 and not significant (NS)

	L2-L4 BMC	L2-L4 BMD	L3 BMC	L3 BMD	L3 Width	Femoral neck BMC, BMD, width, CSMI, CSA, Z
Girls - 1 year	4.7***	2.8***	9.5***	3.1***	2.9***	NS
Girls - 2 year	3.8**	1.2*	7.2***	1.6*	1.8***	NS
Boys - 1 year	3.2**	1.9*	5.2***	2.1*	2.3**	NS
Boys - 2 year	NS	NS	3.0**	NS	1.3**	NS

Table 2: Level of physical activity evaluated by accelerometers ** p<0.01, *** p<0.001

At follow-up	Intervention Girls N=41	Controls Girls N=40	Intervention Boys N=72	Controls Boys N=55
Recording time (hrs/day)	12 (1)	12 (1)	12 (1)	13 (1)
Mean activity (counts/minute/day)	644 (184)	590 (115)	770 (267)	728 (211)
>3 METS (minutes/day)	194 (45)	185 (35)	211 (55)	209 (45)
>6 METS (minutes/day)	34 (15)	35 (12)	44 (21)	48 (19)
>6000 counts/min (min/day)	13 (8)	11 (6)	16 (10)	15 (9)
>10000 counts/min (min/day)	3*** (3)	1 (1)	4** (3)	2 (3)

DXA derived normative data in children and adolescents:

This cross-sectional study was designed to explore the findings of the PE intervention study and to fulfill the requirement of normative data to assess growth in normal children and adolescents (7). For this study, 710 females with a mean age of 13.2 years (range 5.9 - 30.3), and 759 males with a mean age 13.2 years (range 6.4 - 30.4), were included. Participants below the age of 18 were randomly selected from 10 schools in the city of Malmö and adult participants were recruited from surrounding communities. Height and weight were measured according to the standard protocols and BMI was calculated. Using DXA technique, lean mass, fat mass, BMC, and BMD were measured at TB, arms and legs. BMC, BMD, bone size and bone area were measured at LS and FN. Age and sex specific normative data during growth were plotted in one-year age groups as mean (SE).

Results

Anthropometry, muscle mass, fat mass and bone mass:

During pre-pubertal years, gain in height, weight, and TB bone mass is linear and the rate of accrual is similar in girls and boys. When looking at the gain in TB and appendicular muscle mass, boys showed higher muscle mass from the beginning, and with the pubertal growth spurt, sex differences became more apparent. However, the gain in TB and appendicular fat mass showed a different pattern, with girls in general having higher values compared to boys (Figure 1). Further, when looking at the accrual of bone mass and bone size in LS, girls reach peak velocity of BMC and BMD in LS roughly 1.5 - 2.0 years earlier than boys do, in that bone mass accrual in LS increases initially more in girls than in boys of the same chronological age (Figure 2). This could be due to the earlier onset of puberty in girls. This finding clarifies the exercise induced higher gain in LS bone mass and bone size of girls in the intervention group.

Compared to other skeletal sites, BMC and BMD accrual at FN showed a different pattern in both girls and boys. There is a tendency for an early peak and decline in FN bone mass already at the end of

the second decade compared to the stable or slight further increase in TB BMD and LS BMD, (Figure 2), being in accordance with previous reports in Swedish adolescents (15). However, the lower value of FN BMD in girls at all ages compared to boys is also consistent with the literature in Canadian children. In addition, the early onset of bone mass loss in FN compared to LS is also consistent with previous reports (16).

In conclusion, except in LS, adolescent boys showed a higher bone mass, bone size and muscle mass whereas girls showed higher fat mass throughout the measured age range. FN showed a different growth pattern with early peak and decline of bone mass compared to the other skeletal sites. These findings need to be further studied in future longitudinal studies. The present study supports the view of a heterogeneous muscular skeletal development during growth. Findings of this study were published in *ACTA paediatrica* in 2010 (17).

Femoral neck bone strength estimated by HSA:

In our previous published study by Alwis *et al.*, (17), FN showed different age and sex specific growth patterns compared to the other skeletal sites as detected by conventional DXA. Therefore, this study was aimed to evaluate age and sex specific changes in normative FN geometry and biomechanical estimates, and to evaluate whether these changes in FN could compensate for the age related loss of bone mass to maintain FN bone strength. This study was based on HSA measurements of 1760 study participants aged 6-90 years; FN geometry data from age 6 to 19 years were presented in one-year age groups, and from age 20 to 90 years were presented in 10-year age groups.

FN geometric adaptations in children, adolescents and adults:

When plotting the age specific changes in FN BMC, BMD, PD, and ED the curves increased with higher ages until statistically significant break points were reached at age 17 in girls and 19 in boys. A similar pattern was observed in CT, CSA, CSMI and Z (Figure 3). In adulthood, after the break points, while BMC and BMD have decreased, PD and ED

have increased with advancing ages. This showed the distribution of bone mass further away from the central axis of FN (Figure 3).

In adults, as shown in second half of the table 3, the relative decrease in BMC, BMD, CT, CSA, CSMI and Z from peak to old age was more marked

in women than in men, whereas the relative expansion in ED and PD from peak to old age was more marked in men than in women (Table 3). The expansion in ED was greater than the expansion in PD, resulting in a diminishing CT in both sexes, which is more marked in women than in men (9).

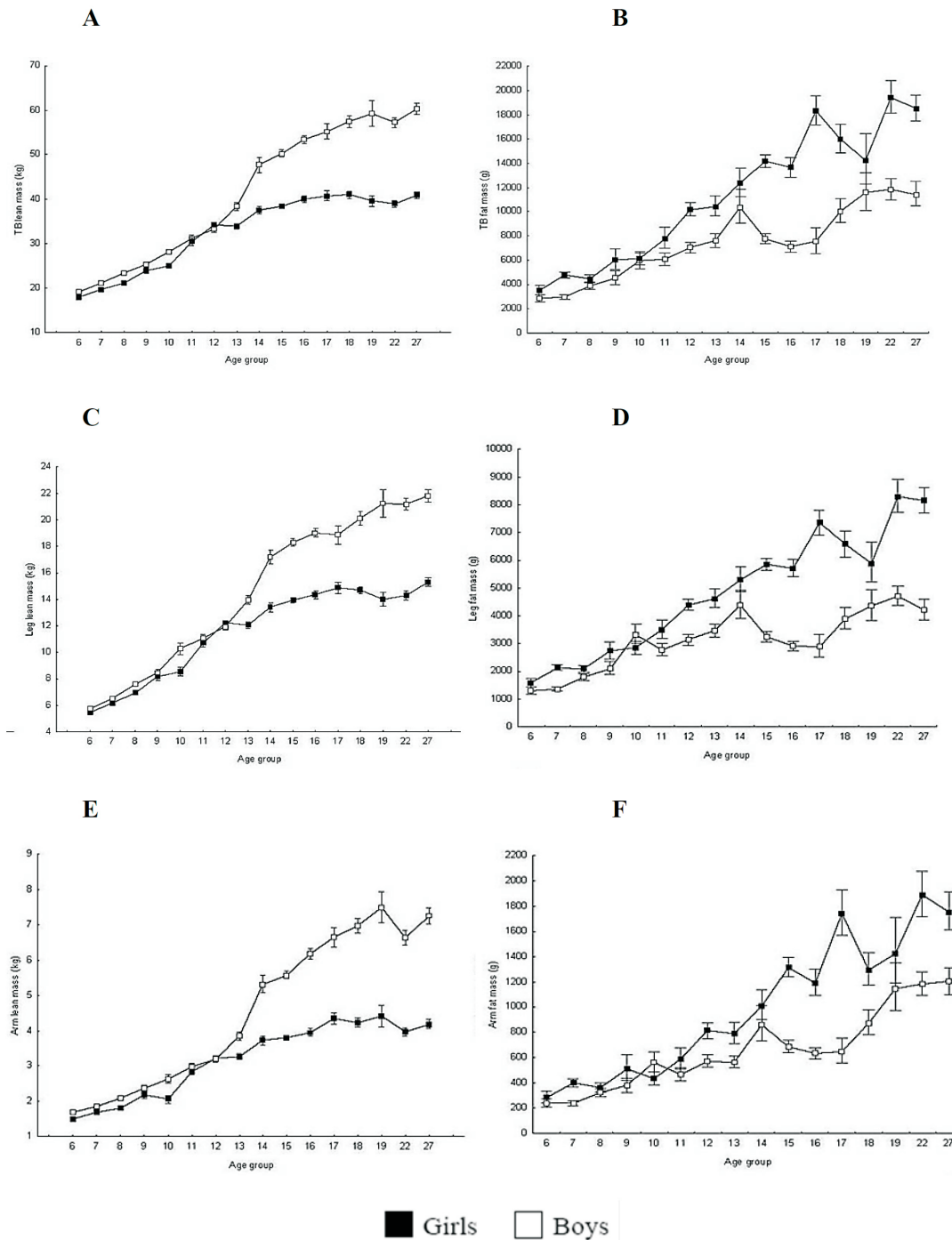


Figure 1: Age and sex specific changes in lean mass and fat mass regions and FN width A- total body lean mass, B- total body fat madd, C- leg lean mass, D- leg fat mass, E- arm lean mass and F- arm fat mass. Data presented as mean (SE)

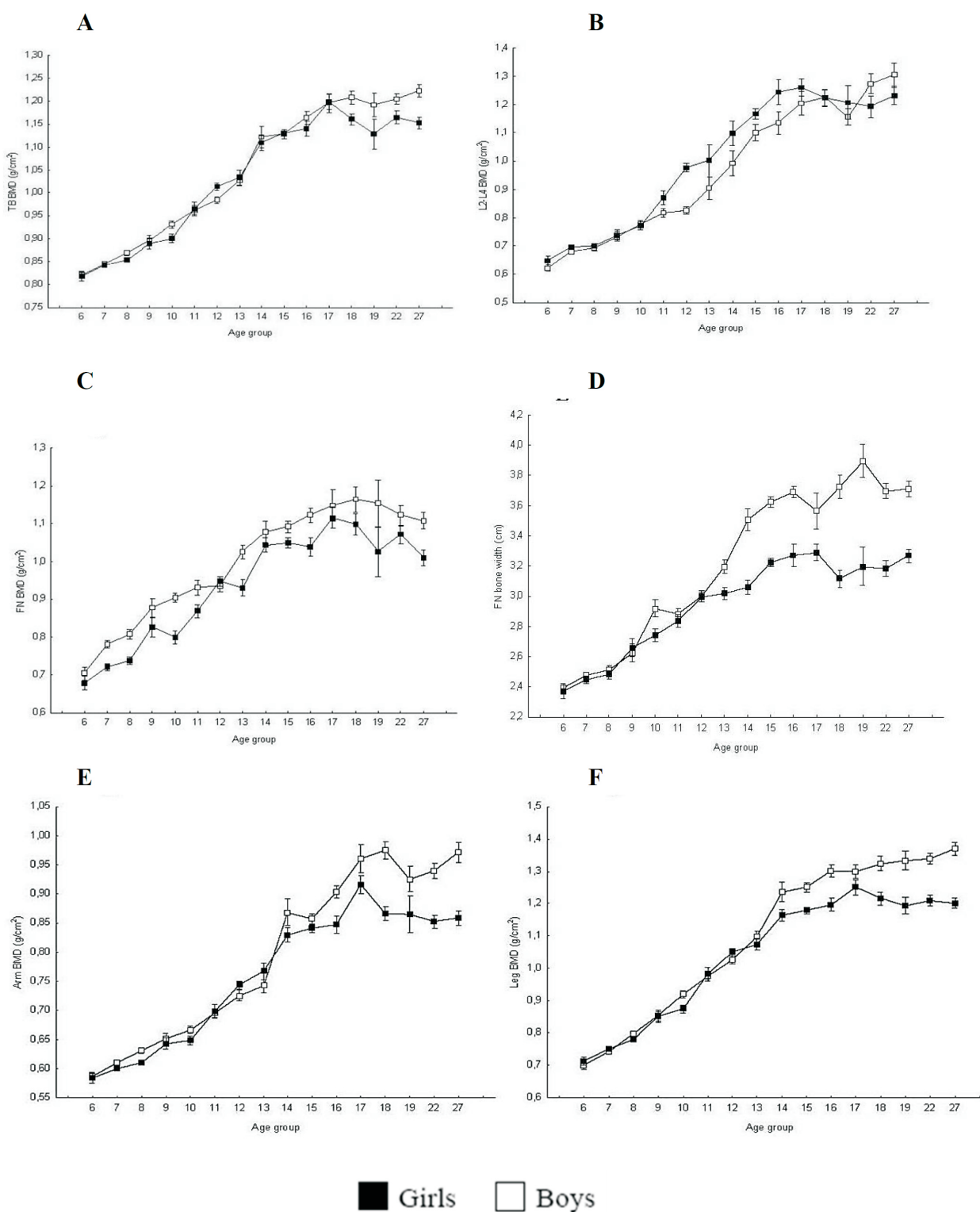


Figure 2: Age and sex specific changes in BMD in different skeletal regions and FN width A- total body, B- lumbar spine, C- femoral neck, DF- FN width, E-arm and F- leg. Data presented as mean (SE)

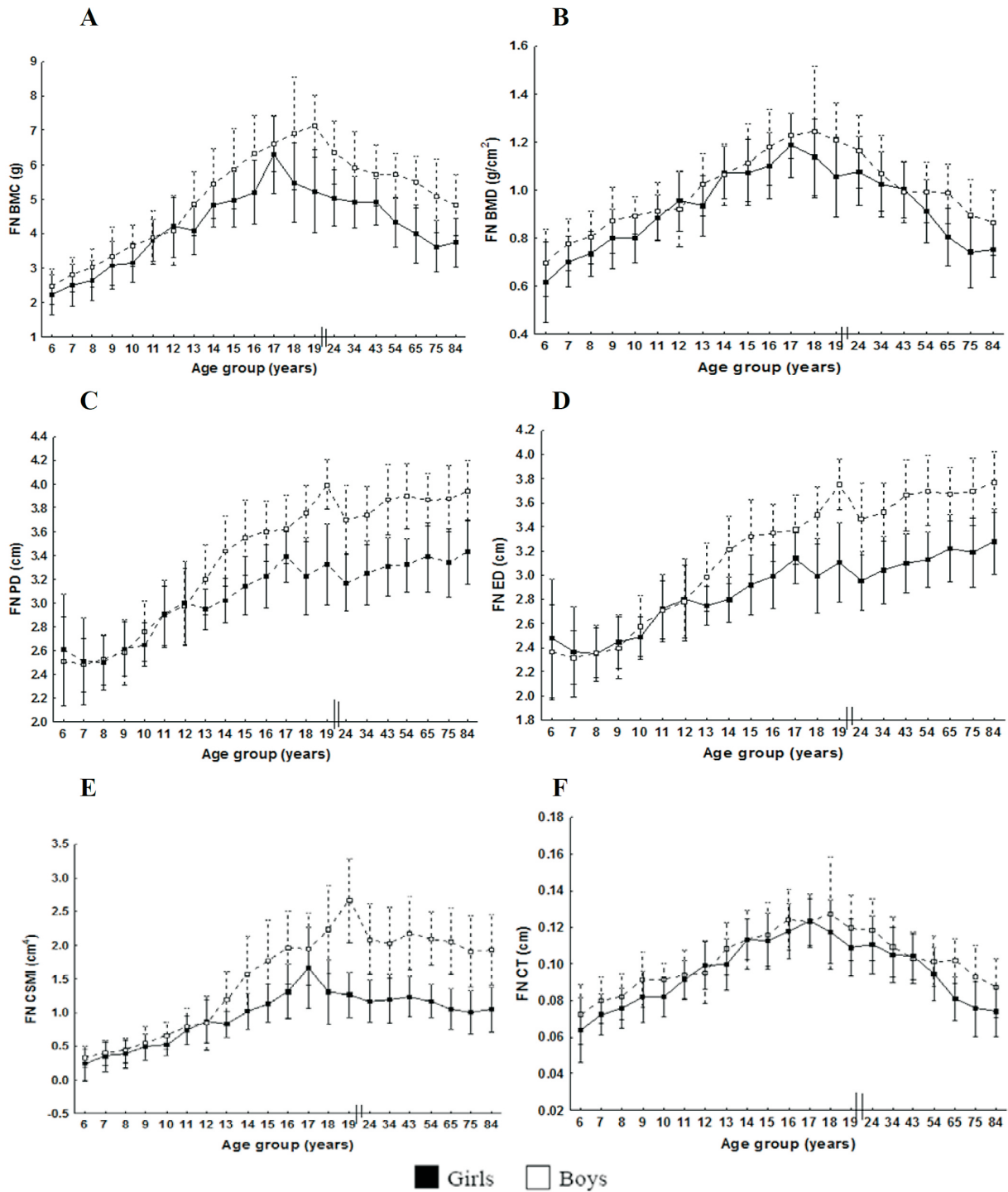


Figure 3: Age and sex specific changes in femoral neck geometric adaptations. A- FN BMC, B- FN BMD, C- FN periosteal diameter (PD), D- FN endosteal diameter (ED), E- FN cross-sectional moment of inertia (CSMI), F- cortical thickness (CT). Data presented as mean (SD)

Table 3: Annual Changes in FN Geometry and Mechanical Estimates. * p<0.05

Variable	Mean relative annual changes before peak point (%)		Mean relative annual changes after peak point (%)	
	Boys	Girls	Men	Women
FN BMC	+10.2*	+ 9.2*	-0.4*	- 0.6*
FN BMD	+ 4.9*	+ 5.8*	-0.4	- 0.6*
FN PD	+ 4.7*	+ 3.1*	+0.1*	+0.1
FN ED	+ 4.7*	+ 2.8*	+0.2*	+0.1
FN CT	+ 5.0*	+ 6.0*	-0.5*	- 0.7 *
FN CSA	+10.0 *	+ 9.1*	-0.3	- 0.6 *
FN CSMI	+21.1*	+15.5*	0.0	- 0.3
FN Z	+15.9*	+12.0*	-0.1	- 0.3*

The finding that sex discrepancies in the development of bone mass and FN geometry adaptations during puberty continues into adolescence and adulthood, could explain the higher risk of FN fractures in women compared to men.

In conclusion, age related loss of FN bone mass is partly compensated by the increase in FN diameters and biomechanical indices. These structural and biomechanical adaptations are important to maintain FN bone strength. Preservation of FN bone strength in elderly is more obvious in men than in women. Findings of this study were published in *Calcified Tissue International* in 2012 (18).

Associations of anthropometry and body composition on FN geometry in children and adolescents:

Anthropometry and body composition are important factors associated with bone strength. The study was aimed to evaluate the relationships of anthropometry and body composition on FN geometric indices in children and adolescents.

For this study, 256 girls and 303 boys aged 6 to 14 participated and the adolescent group comprised of 326 girls and 319 boys aged 10 to 19.0 years. FN geometric indices and biomechanical properties evaluated by HSA at the narrowest FN were considered as dependent variables. These five FN development predictors; body weight, body height, BMI, TBLM and Log-transformed TBFM, were

considered as the independent variables. Pearson correlation (r) and advanced, step-forward multiple regression analysis were applied.

Results

Anthropometry and body composition measures of girls and boys in both pre-pubertal and adolescent groups show that boys are significantly taller and heavier with significantly higher TBLM and lower TBFM compared to girls of similar BMI. In pre-pubertal girls and boys, height showed the greatest independent positive association with all FN geometric indices whereas in adolescents, TBLM showed the greatest independent positive association with all FN geometric indices, especially in boys. TBFM showed negative associations with FN bone mass and geometry in pre-pubertal children and adolescent boys.

In conclusion height in pre-pubertal children and TBLM in adolescents showed the greatest independent positive associations with FN geometry -especially in boys. Fat mass showed negative association with FN geometry and bone mass in pre-pubertal children and adolescent boys.

As childhood obesity is an increasing problem, findings of the current study showed an increasing interest in both the clinical and the research situations when trying to prevent obesity associated growth disturbances during growth. Relative independent positive association of lean mass and

negative association of fat mass on FN geometry in children and adolescents need to be investigated in future longitudinal studies. The findings of this study were presented as abstracts in the 25th annual scientific meeting of International Society for Clinical Densitometry (ISCD 2019) in Kuala Lumpur Malaysia (19, 20, 21).

Overall Conclusions

School-based moderately intense PE exercises have direct beneficial effects on increasing the bone strength in LS in pre pubertal children. The age and sex specific total and regional soft tissues, bone mass in the different skeletal sites were observed, with the appendicular skeleton having an extended period of increased BMC into adulthood compared to the axial skeleton. Age related loss of FN bone mass is partially compensated by changing the FN bone geometry. Height in children and TBLM in adolescents show the greatest independent positive associations with FN geometry, especially in adolescent boys. In addition, the increase of the muscle mass and decrease of the fat mass seems to have beneficial effects on developing better femoral neck geometry, especially in boys. Despite the fact that this study was conducted in Sweden with Swedish children and adolescents, applying this message in Sri Lanka and allowing the Sri Lankan children to play in an enjoyable environment would be an important approach when aiming better musculoskeletal health.

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Demographic influences on the performance of three memory tests by Sri Lankan older adults

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ABSTRACT

Introduction: Loss of memory is the hallmark of dementia. In Sri Lanka, validated tests are not available for assessment of memory. The objective of the project was to study performance of Sri Lankan older adults on three memory tests: Lankan Verbal Learning Test (LVLT), Benton Visual Retention Test (BVRT) and Modified Enhanced Cued Recall Test (MECRT).

Methods: Participants were 241 healthy individuals aged between 50 to 80 years. They were individually administered the tests by a research assistant. The LVLT is a verbal list learning task. The BVRT contains geometric figures that are presented in the recognition memory format. The MECRT assesses the memory for pictures aided with semantic cues.

Means of test scores were calculated and compared for gender, age and levels of education. Multiple linear regression models were used.

Results: The mean age was 63 (SD=7.7) years. Gender effect was prominent on verbal memory scores. The test scores were influenced by gender and education level. Gender, age and education together explained 15.6% and 9.6% of the variance of verbal memory score and visual recognition memory score respectively. Variance of MECRT scores were minimally explained by demographic variables.

Conclusion: MECRT is the least influenced by demographic factors and could be used for Sri Lankan older persons irrespective of their gender, age and education.

Keywords: *Dementia, demographic variables, memory tests, neuropsychological assessment, Sri Lanka*

Introduction

Neuropsychological testing is an integral part in the assessment of neurocognitive disorders such as dementia, especially in the early stages. Dementia is characterised by amnesia with additional deficits in other cognitive domains. Therefore, assessing memory is important for making the diagnosis, development of intervention plans, monitoring disease progression and assessing effects of

treatment. Many screening instruments and tests of different forms of memory (1) are being in wide use in developed countries but are scarce in developing countries such as Sri Lanka.

Sri Lanka has been rated as the fastest ageing population in South Asia (2). Country's share of population aged over 60 years will reach almost 30% by 2050. In this backdrop prevalence of dementia is expected to rise in the country.

Some tools for assessment of cognitive functions are validated for Sri Lankan population (3-9). Among them, the most frequently used tool is Sinhala version of Mini-Mental State Examination (MMSE). MMSE is a widely used screening tool throughout the world, it has most of the qualities of a good screening instrument described by Parker and Philip (10), but it assesses memory impairment only to a limited extent; it is also criticized for lack of specificity, particularly among less educated individuals. Therefore it is essential to develop and validate culture appropriate tests for assessing different forms, processes and operations of memory easily applicable for diverse sectors of Sri Lankan population including very old, illiterate and impaired individuals.

List learning tests such as Hopkins verbal learning test-revised (1) is a widely used measure of verbal learning and memory. It has been useful in detecting dementia; moreover according to Hogervorst (11), some of its scores found to be more sensitive than MMSE to the presence of dementia.

Enhanced cued recall test is a memory test which can be used with individuals with cognitive impairment including memory deficits as it uses pictures and provides cues to enhance storage and retrieval of information (12). This test has reported high sensitivity and specificity to discriminate demented from non-demented elderly (13).

Benton Visual Retention test is used to assess visual memory (14). It has different types of administration, including multiple choice version which is a measure of subject's visual recognition memory; it minimally relies on language.

Objective of our study was to compare performance on Lankan Verbal Learning Test, Modified Enhanced Cued Recall Test and Benton Visual Retention Test in a sample of healthy Sri Lankan older adults.

Methods

Our sample consisted of 241 randomly selected healthy subjects aged 50 to 80 years living in a semi urban community. Sample size was decided based on the sample sizes of previous such studies (8). Subjects were selected from randomly selected areas from cluster sampling method in a door to door survey in Bope-Poddala MOH area in Galle

district which represents typical Sinhala speaking semi-urban community in southern part of the country. Medical records were reviewed and people with major psychiatric disorders, neurological conditions, uncontrolled diabetes, severe hearing or visual impairments were excluded. Potential subjects were screened for cognitive decline with Geriatric depression scale validated for Sri Lanka (6) and Modified version of the Short Form of Informant Questionnaire on Cognitive Decline and a brief functional screening instrument adapted to Sri Lanka (5). Those who did not meet criteria for depression and cognitive decline were invited to take part in the study. Neuropsychological tests were individually administered for each participant by a trained research assistant. Ethical approval for the study was obtained from the ethical review committee of Faculty of Medicine, University of Ruhuna.

Lankan verbal learning test (LVLT)

The LVLT is a verbal list learning task modeled after Hopkins verbal learning test-revised (15), in which participants were required to learn 12 words drawn from 3 categories over 3 learning trials. After each presentation of the list, the subject was asked to recall as many words s/he could. Following 20 minutes filled delay, the subject was asked for a free recall and in addition to recognise the words from a list with target words and distractors. Three measures of verbal memory are obtained from the test. The total recall score is the number of words recalled over the 3 trials (free recalls). To calculate the percent retained after the delay (% retention), 20 minute delay recall is divided by the best of trial 2 and 3. The recognition discrimination index (RDI) is the number of true positives minus the number of false positives in the recognition trial.

Modified Enhanced Cued Recall Test (MECRT)

MECRT was originally developed by Grober, *et al.* (12) and in the current study, items of the original version were replaced with culturally appropriate items (eg: grapes replaced with bananas) but in the administration, procedures described in the original version were used.

In MECRT line drawings of 16 items in four different cards (4 items in each) were presented to the participant. In the presentation of the first card, while the subject was examining the items on the card, examiner gave semantic cue for each item and asked the subject to name the matching drawing. If the subject correctly names it (Any variations of the dialect, including the English word were considered as correct. The participant is expected to produce the same name to indicate the particular item in his recalls), the examiner moves to the next item. After 4 items on the card were correctly named, the card is removed. Immediate recall was tested and the subject is asked to name each of the items after the same semantic cue is given by the examiner. This procedure was followed for all 4 cards. After all 4 cards were presented, the subject was asked to name as many items he/ she could recall (free recall); after the free recall, examiner provided semantic cues to help recall the remaining items (cued recall). After 20 minute filled gap, subject was again asked for a free recall of the items on the cards and cued recall of remaining items. In the analysis, number of items recalled over 1st free recall, 1st cued recall, delayed free recall, delayed cued recall, total number of free recalled items (in each of the 2 trials), total number of cued recall items (in each of the 2 trials) and total recalls were used. Total recall was the sum of free and cued recall items for each of the trials.

Benton Visual Retention Test (BVRT)

The administration M of the test was used. BVRT contains 15 geometric figures of varying complexity that are presented in the recognition memory format. Each item is shown for 10 seconds followed by a multiple choice page containing the target item and 3 foils. The participant is asked to select the target item (the one shown for 10 seconds) from among distracters. The number of correct responses was used as the measure of visual memory.

Analyses were conducted using Statistical Package of Social Science (SPSS) version 20. There is evidence that the genders differ in the performance on verbal memory tests. The sample was divided into two age categories; 50- 64 years and 65 years and above. Independent sample T test was used to compare mean test scores. The education levels were categorized as primary education (upto 5

years), 5-10 years of schooling and above 10 years of formal education. One-way ANOVA was used to compare test scores among age groups. Test scores were displayed as means, standard deviation for each gender, age category and education level. Mean scores within each group were compared and level of significance was set at .01 to control for inflated error rates.

Linear regression models were used to assess the effect of gender, age and education on tests scores simultaneously.

Results

The sample was dominated by females (64%, n=154). The mean age was 63 (SD=7.7) years. Twelve percent of the sample was either illiterate or had very little education. Nearly half of the sample reported their monthly income below poverty line. Demographic features of the sample are summarized in table 1.

All the participants (N=241) were able to perform all the 3 tests. A large majority of participants (92%) achieved ceiling score for the two scores of MECRT; total number of recalls in each of the immediate recall and 20 minute delayed recall.

Analysis revealed that the test scores were influenced by gender and the years of formal education, but the influence of age on test scores was minimal. Gender has no effect on BVRT score but was prominent on all LVLTL scores; females out performed males. Means of the test scores and their standard deviations for both males and females are summarized in Table 2.

The mean test scores and standard deviations were calculated for test scores for two age groups. These data are provided in Table 3. Elderly group (aged above 64 years) demonstrated comparative levels of performance to their younger counterparts. As table 3 shows none of the differences of mean test scores in the two age groups were statistically different.

For analysis participants were divided into 3 groups based on their level of formal education. Mean test scores, and standard deviations were calculated for each of these 3 groups and these data are provided in Table 4. People with most years of

education obtained better scores compared to those with least years of education.

Multiple linear regression model was used to learn effect of gender, age and education on test scores. In linear regression model, reference group for gender was the male group, for age it was the young group (50-64 years). The sample was divided in to two levels of education; up to 10 years and above 10 years of formal education. For education, the reference group was the group up to 10 years of education. The higher educated group was compared to the reference group.

Results of Multiple linear regression is shown in Table 5.

Gender, age and education together explain upto 16% of the variance in LVLТ scores and almost 10% of the variance in BVRT score while variance in MECRT scores were least explained by gender, age and education level of the participants.

Table 1: Demographic characteristics of the sample

Variables	N (%)
Age (in years)	
50 - 64	140 (58)
65 - 79	101 (42)
Sex	
Female	154 (64)
Male	87 (36)
Educational status	
Upto 5 years	28 (12)
6 to 10 years	142 (59)
More than 10 years	71 (29)
Employment status	
Employed	60 (25)
Retired/ Not working	115 (48)
Never worked	66 (27)
House-hold monthly income	
Up to Rs. 10,000/-	111 (46)
Rs. 10,000/- to Rs. 20,000/-	82 (34)
More than Rs. 20,000/-	47 (20)

N - Number of participants, % - percentage of participants

Table 2: Test scores for males and females; mean and standard deviation (SD) for 3 memory tests (N=241)

Test Score	Males (n=87) Mean (SD)	Females (n=154) Mean(SD)	P value
LVLТ			
Total recall	18.8 (3.2)	21.7 (3.7)	0.001
* % retention	72.4 (22.8)	80.6 (18.1)	0.002
** RDI	7.1 (.17)	8.5 (.14)	0.001
BVRT	10.6 (.24)	10.2 (.23)	0.37
MCERT			
1 st free recall	8.2 (1.9)	8.6 (2.1)	0.151
*** 1 st cued recall	7.7 (1.9)	7.3 (2.1)	0.180
Delayed free recall	8.5 (2.2)	9.3 (2.4)	0.010
*** delayed cued recall	7.5 (2.2)	6.7 (2.4)	0.013
Total free recall	16.7 (3.8)	17.9 (3.9)	0.030
Total cued recall	15.1 (3.7)	14 (3.9)	0.024

* one outlier removed for analysis

** as the distribution of was skewed, score was converted to square root for calculation of means

*** cues were given only for the items individual failed to freely recall.

Table 3: Test scores for age: mean and standard deviation (SD) of scores of 3 memory tests (N=241)

Test Score	Age		P value
	Upto 64 yrs (n=140)	Above 64 yrs (n=101)	
	Mean (SD)	Mean (SD)	
LVL			
Total recall	21.1 (3.6)	20.1 (3.9)	0.041
*% retention	77.1 (21.7)	78.5 (18.3)	0.604
**RDI	8.1 (0.15)	7.8 (0.17)	0.343
BVRT	10.6 (0.22)	10.2 (0.24)	0.413
MECRT			
1 st free recall	8.6 (2.1)	8.3 (2.1)	0.358
***1 st cued recall	7.4 (2.0)	7.6 (2.1)	0.338
1 st total recall	15.9 (0.31)	15.9 (0.3)	0.537
Delayed free recall	9.3 (2.3)	8.6 (2.6)	0.022
***Delayed cued recall	6.7 (2.2)	7.3 (2.5)	0.051
Total free recall	17.9 (3.8)	16.9 (4.1)	0.059
Total cued recall	14.1 (3.6)	14.9 (4.1)	0.084

*one outlier removed for the analysis

**scores were converted in to square root for calculations as the distribution was skewed

***cues were given only for the items individual failed to freely recall

Table 4: Test scores for level of education: mean and standard deviation (SD) of scores 3 memory tests (N=241)

Test Score	Years of education			P value
	Upto 5 yrs. (n=28)	6 to 10 yrs. (n=142)	Above 10 yrs. (n=71)	
	Mean (SD)	Mean (SD)	Mean (SD)	
LVL				
Total recall	18.9 (2.9)	20.8 (3.8)	21.1 (3.9)	0.023
*% retention	78 (22.5)	76.2 (20.2)	80.6 (19.6)	0.318
**RDI	6.5 (0.25)	8.1 (0.14)	8.4 (0.12)	0.001
BVRT	7 (0.41)	10.4 (0.17)	12.3 (0.12)	0.001
MECRT				
1 st free recall	7.2 (2.3)	8.6 (2.0)	8.6 (1.9)	0.002
***1 st cued recall	8.6 (2.1)	7.3 (2.0)	7.3 (1.9)	0.004
1 st total recall	15.8 (0.5)	15.9 (0.3)	15.9 (0.3)	0.182
Delayed free recall	8.1 (2.7)	9 (2.4)	9.2 (2.2)	0.139
***Delayed cued recall	7.7 (2.5)	6.9 (2.3)	6.8 (2.3)	0.172
Delayed total recall	15.9 (0.4)	15.9 (0.3)	15.9 (0.3)	0.397
Total free recall	15.3 (4.4)	17.7 (3.9)	17.8 (3.6)	0.009
Total cued recall	16.4 (4)	14.2 (3.8)	14.1 (3.7)	0.017

*one outlier removed for the analysis

**scores were converted in to square root for calculations as the distribution was skewed

***cues were given only for the items individual failed to freely recall

Table 5: Results of Multiple linear regression; association of scores of 3 memory tests with gender, age and education (N=241)

Score	Covariate	Coefficient	SE	T	P value	95%CI for coef.		Adj. R ²
LVL								
Total recall	Gender	2.945	.465	6.328	0.001	2.028	3.862	15.7%
	Age	-1.024	.454	-2.256	0.025	-1.98	-.130	
	Education	.834	.491	1.697	0.091	-.134	1.801	
% retention	Gender	8.256	2.684	3.077	0.002	2.970	13.543	3.6%
	Age	1.248	2.612	.478	0.633	-3.898	6.394	
	Education	4.072	2.837	1.435	0.152	-1.517	9.661	
RDI	Gender	.259	.051	5.091	0.001	.159	.360	10.6%
	Age	-.048	.050	-.976	0.330	-.146	.049	
	Education	.119	.054	2.198	0.029	.012	.225	
BVRT	Gender	-.057	.061	-.929	0.354	-.178	.064	9.6%
	Age	-.079	.060	-1.313	0.190	-.196	.039	
	Education	.333	.065	5.145	0.001	.205	.460	
MECRT								
1 st free recall	Gender	.396	.276	1.437	0.152	-.147	.939	0.3%
	Age	-.257	.269	-.958	.339	-.787	.272	
	Education	.245	.291	.843	.400	-.328	.818	
1 st cued recall	Gender	-.364	.272	-1.340	0.182	-.898	.171	0.1%
	Age	.263	.265	.994	0.321	-.259	.785	
	Education	-.228	.287	-.794	0.428	-.792	.337	
Delayed free recall	Gender	.744	.320	2.322	0.021	.113	1.375	3.4%
	Age	-.734	.312	-2.351	0.020	-1.350	.119	
	Education	.279	.338	.824	0.0411	-.387	.945	
Delayed cued recall	Gender	-.776	.309	-.2510	0.013	-1.384	-.167	3.3%
	Age	.607	.301	2.015	0.045	.014	1.201	
	Education	-.314	.326	-.962	0.337	-.956	.329	
Total free recall	Gender	.1140	.522	2.184	0.030	.111	2.168	2.6%
	Age	-.992	.509	-1.948	0.053	-1.995	.011	
	Education	.524	.551	.951	0.343	-.562	1.609	
Total cued recall	Gender	-1.162	.511	-2.275	0.024	-2.169	-.156	2.5%
	Age	.889	.498	1.784	0.076	-.093	1.870	
	Education	-.515	.539	-.954	0.341	-1.577	.548	

Discussion

Our study demonstrates that the three memory tests could be applied even to those without any formal education.

We observed that all test scores of LVL are higher in females. This finding is consistent with the findings of other studies which report female superiority of verbal/ language based test performance (16). Our results revealed that the percent retention score is influenced only by gender but not by age or education. In contrast verbal recognition memory (RDI score) found to be influenced by gender as well as level of education. Female gender and having more years of education lead to better accuracy of the verbal recognition memory.

Memory decline with ageing is considered to be normal (17, 18). We observed slightly better performance in some scores by the group who is less aged. However our study reveals that performance of these three memory tests are not influenced by age in cognitively normal older adults.

Effects of education is marked on the test scores; those with little formal education performed poorly. This effect was prominent on free recall scores, but it does not have the effect on aided memory scores; that is those with little or no formal education performed as well as those with several years of formal education when encoding and retrieval of information are facilitated with semantic cues.

Multiple linear regression analysis showed that a large proportion of variance (10%) in visual memory score was explained by gender, age and education. This finding contradicts the well-known fact that non-verbal tests are culture free. Our results indicate that those with no or primary education scored low for BVRT. Therefore we believe that clinicians should be cautious in using this test for illiterate/ poorly educated subjects and in making interpretations of their score. In contrast, ECRT demonstrated to be a culture free test which could be used with older Sri Lankan populations irrespective of their gender, age or level of formal education. Literature underscores the importance of using culture free tests with elderly and illiterate populations as they provide less threatening situation in which older people can fully demonstrate their ability independent of language and level of education.

Our study highlights influence of demographic variables on test performance. It also points to limitations and strengths of these tests. Major limitation of this study is limited number of participants.

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Development and assessment of the psychometric properties of a new scale (15 item PSB-CL) to monitor the psychosocial burden of chronic lymphoedema in filariasis

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ABSTRACT

Introduction: Chronic lymphoedema (CL) of lymphatic filariasis causes severe psychosocial burdens (PSB) to its victims. Currently-established scales to measure PSB of CL are not culturally adaptable to Sri Lankan patients. In this study, we developed and assessed the psychometric properties of a disease-specific questionnaire (15 item PSB-CL).

Methods and Results: A detailed literature search was done to identify scales related to PSB of CL patients. Questions were developed through collected expressions from semi-structured interviews with 46 CL patients. A response scale was developed from the collected pool of possible responses, and they were scored using a visual analogue scale. Face and content validity were carried out using an initial questionnaire (31 questions). They were reduced to 27 by removing unclear, ambiguous, double-stranded ones and those with value-laden words. This new questionnaire was administrated on 92 patients by a group of doctors for item reduction by the analysis of internal consistency (Cronbach's $\alpha \geq 0.7$) and factor analysis (Principal Component Analysis; Eigenvalues ≥ 1). After the patient survey and factor analysis, the final questionnaire PSB-CL was formed with 15 questions that had four subscales (factors), physical, social, fear and humiliation. Patients (n=92) reported quite a large percentage (42% - 69%) of problems under each dimension.

Conclusion: The scale to measure the psychosocial burden of chronic lymphoedema in lymphatic filariasis patients in Sri Lanka. Further validation of the tool is needed.

Keywords: *Lymphatic filariasis, measuring scale, psychosocial burden*

Introduction

Lymphatic filariasis (LF) is a tropical disease caused by thread-like worms - *Wuchereria bancrofti*, *Brugia malayi*, *Brugia timori* - living in the human lymph system (1). LF is one of the leading neglected tropical diseases, which causes debilitating and disfiguring conditions (2). Lymphoedema (elephantiasis), acute episodes of

adenolymphangitis (ADL), hydrocoele, lymph scrotum, and chyluria are due to the damage of lymphatic systems. Other symptoms such as arthritis, renal diseases, and tropical pulmonary eosinophilia (TPE) are also ascribed to extra-lymphatic filarial infection (3, 4). Acute episodes of ADL, lymphoedema and hydrocoele are the three principal manifestations of LF that cause severe suffering (5).

It has been reported that more than one billion people are at risk of infection, of whom 120 million are infected in endemic countries before the establishment of the global programme to eliminate lymphatic filariasis (GPELF) in 2000 (6). The prevalence of lymphoedema and hydrocoele were estimated to be 3% and 6.2% respectively in the three suburbs of Matara, Sri Lanka (7). Previous estimates to the whole population at risk (10 million) were scaled up to give an expected 300,000 cases of lymphoedema and around 300,000 cases of hydrocoele in eight endemic districts of Sri Lanka (8). As for acute episodes of ADL, 46.6% to 58.4% of lymphoedema patients have experienced ADL at least once in Sri Lanka (9-11).

There are several medical and surgical options developed recently to alleviate suffering from lymphoedema. Those include morbidity management and disability prevention (MMDP) with hygiene improvement, limb elevation and exercise, topical application of antibiotics/ antifungals to prevent infections and surgical resection (12-14).

MMDP programme is to alleviate suffering of individuals who are not fully capable of long-term self-care maintaining the near-normal life. Patients should reach the highest possible degree of independence, autonomy, participation and personal fulfilment by activities carried out at home by themselves or by formal/ informal carers (family, friends, neighbours, traditional carers and volunteers) (14).

However, psychological distress, social dysfunction and coping strategies of patients with chronic filariasis can hamper rehabilitation of the affected. The resumption of near 'normal life' of such patients becomes unreal. Studies carried out in the past by many scientists have documented the psychological burden associated with LF (8,11,15,16,17). Studies carried out in Sri Lanka specially recorded physical, mental and social suffering due to lymphoedema (9,11,18).

Formulation and validation of a tool to assess the psychological burden of LF patients in Sri Lanka would be valuable to the current MMDP programme because the medical officers who are attached to primary health care settings may not have the capacity to identify psychological burden with ease. Therefore, incorporation of such a developed

tool will facilitate the assessment of the psychosocial burden of LF patients in current MMDP programme (17-19). Its expression should be based on cultural norms and values and collection of information from the affected people without a pre-occupied conceptual framework. Thus, the current study was aimed to develop a new scale to be used in local settings to identify the psychosocial burden of chronic lymphoedema in LF patients. In this article, only the development of the scale and assessment of properties are explained.

Methods

The PSB-CL questionnaire was designed based on standardised health care, health-related quality of life (HRQoL) questionnaire development, and validation methodology proposed by WHO (19). The questionnaire was developed in four phases; item generation, item selection, dimension reduction, response development and evaluation (19). Suitable responses to the questions were also developed and evaluated using participants living in the community. Appropriate phrases for the answers were formulated using focus-group discussions with the patients. Thus, item development, item selection, item reduction, response development, response selection, questionnaire formulation and content validation of the questionnaire were made during the first stage of the study. In the second stage, secondary question reduction was conducted using exploratory factor analysis to develop the final questionnaire (19).

Item development: A critical review of existing tools to measure the psychosocial burden of LF was carried out by a six-member committee comprised principal investigator, two senior parasitologists, a clinical psychologist, a behavioural science specialist and a physiologist.

None of the scales captured behaviour, feeling, or actions related to psychosocial dimensions of local people as we expected. Therefore, key informant interviews were planned as the source of items. A topic guide was developed by carrying out three in-depth interviews with local patients by the authors. The authors JR, CY, CS and BP have conducted in-depth interviews with the patients. Patients were selected from the patient databases

at FRTSU, University of Ruhuna considering age, sex, grade of lymphoedema and social background (Table 1). Patients from endemic communities in Galle and Matara, Sri Lanka, were included in the databases. Interviews were audio-recorded and transcribed.

In-depth interviews lasted for 1.30 to 2.30 hours; more than half a day to transcribe one script. Patients were interviewed until no new themes emerged.

Careful analysis of transcriptions produced several dimensions of psychosocial burden of LF. A series of expressions related to such domains were categorised; some expressions placed in more than one dimension.

Table 1: Distribution of demographic data and the stages of the lymphoedema of participants (n=46)

		No.	(%)
Age	Mean	49.61	
	SD	16.25	
	Range	18-80	
Sex	Female	34	(73.9)
	Male	12	(26.1)
Marital status	Married	31	(67.4)
	Married but living separately	2	(4.3)
	Unmarried but living together	2	(4.3)
	Unmarried	7	(15.2)
	Divorced	1	(2.3)
	Widowed	3	(6.5)
Education	No formal education	3	(6.5)
	Up to primary education	14	(30.4)
	up to O/L	9	(19.6)
	up to A/L	17	(37.0)
	University degree	3	(6.5)
Occupation	Employed	22	(47.8)
	Unemployed	24	(53.2)
Monthly income	<Rs. 10,000/=	1	(2.3)
	Rs. 10,001/= to 20,000/=	27	(58.7)
	Rs. 20,001/= to 30,000/=	14	(30.4)
	> Rs. 30,001/=	4	(8.6)
Lymphoedema Grade	Grade I	3	(6.5)
	Grade II	20	(43.5)
	Grade III	16	(34.8)
	Grade IV and above	7	(15.2)

Item selection: Transcripts were analysed using a systematic approach to thematic analysis based on principles of the grounded theory which is an inductive approach aiming to derive theoretical construction by identifying repeated themes (repeating ideas) in transcripts (21). Selected items were pre-tested to ensure that local patients understood them; that they were unambiguous and the questioned only once. A Likert-type scale ranging from 1 (not clear/not frequent/not important) to 5 (very clear/ frequent/ important) was prepared to pre-test the questionnaire. Each expression was assessed by experts (authors, including the principal author) and given a grading to the Likert-chart. The grading of selected items was analysed by assessing the degree of concordance among experts using Cronbach's alpha (Table 2). Finally, a qualitative reduction of the items was carried out based on the Cronbach's alpha derived from the experts' responses. Not clear/ not frequent/ not important questions were rewritten and pre-tested again using the same methodology. Discarded items were not endorsed by many as important.

Responses development and response selection:

The responses expressed the level of agreement for the intensity or frequency of the patients' problem generated through the patient's transcriptions (20). Out of response pool, two anchor points were then selected as "Not at all" considered getting zero points while "Extremely or Every time" got 100 points. The group of patients (n=30) and research experts (n=9) asked to score for the given responses between zero and 100 using a visual analogue scale (100 cm). Visual analogue scale scores were analysed according to the frequency placed consecutively in between end responses. Responses showing inconsistency were discarded.

Selected responses were coupled with questions in the most suitable positions. However, depending on some questions (whether they were measuring frequency, intensity or duration of the problem) if there were two responses with similar score, they had to be placed in the same positions to facilitate comprehension of questions.

Repeat pre-testing and face validity: The preliminary questionnaire that consisted of 31 (Table 2) questions was administrated to a group of 20

patients by the principal investigator. Administrative problems, patients' response errors and other difficulties were documented. To assess the administrative issues, the clinical practitioner was asked to simply rate each item on a five-point Likert-scale ranging from Extremely Suitable to Irrelevant (22).

Reduction of attributes: The first stage of question reduction was completed, considering the results of the face validation phase. The internal consistency of the scale was analysed using Cronbach's alpha (23) to eliminate one attribute at a time. Item validation was done using item-total correlation and eliminated if the Pearson's r was less than 0.200. We then ranked all attributes starting with the highest correlation. Cronbach's alpha coefficient of ≥ 0.700 was considered satisfactory (Table 2).

Factor analysis: The final questionnaire (15 attributes - Table 3) was administered by trained pre-intern medical doctors and the principal - investigator to patients from Galle and Matara districts. Sample adequacy was measured using Kaiser-Mayer-Olkin test. The data set was analysed using principal component analysis by having direct Oblimin rotation. However, Pattern Matrix showed none of the convergence value was greater or equal to 0.32. Therefore Varimax rotation with Kaiser Normalization was used in the factor analysis using SPSS software to evaluate possible factors (themes) of PBS-CL. Based on eigenvalue (1 or more), factors were removed from the PBS-CL scale.

Results

Item development, content validity and item reduction

Forty-six (46) in-depth interviews were conducted. The mean age of the sample subjects was 49.6. Table data are summarised in Table 1.

Five (05) major dimensions related to psychosocial burden of patients were identified through the coding process. Expressions related to the identified dimensions were then recognised. Some expressions were placed in more than one dimension. Five major dimensions were i) restriction in social

activities due to lymphoedema, ii) limitation of physical activities due to the lymphoedema, iii) fear of worsening the disease condition and deterioration of disability in the future, iv) the extent to which they were humiliated due to the lymphoedema condition, v) actions and thoughts related to psychological defence mechanisms.

In the process of face validation, 31 expressions were identified from the primary 48 expressions by removing ambiguous, complex questions and questions with value-laden words and jargon terms. They were transformed into statements (attributes) (Table 2).

Eight patients (08) out of twenty (20) described some questions as difficult to answer and requested further clarification. Four (04) such questions were removed from the preliminary questionnaire with 31 attributes. Following content validity, the expert panel has identified 27 attributes (Table 2).

Response development and response selection: Intensity measuring responses were developed as, (a) Not at all (b) to some extent (c) usually (d) on most occasions (e) extremely and frequency measuring responses were developed as (a) Not at all (b) sometimes (c) usually (d) often (e) every time.

Table 2: Item reduction by face and content validity (extremely suitable [100%] or irrelevant [$< 25\%$]) and by internal consistency assessment (Cronbach's $\alpha \geq 0.700$)

Attributes	Relevancy & Clarity	When removed α is = 0.700
1 Has your diseased condition affected adversely to your day to day activities?	100%	No
2 Do you experience any discomfort during travelling as a result of this disease condition?	100%	No
3 Do you get the assistance of the others in attending to your work as a result of this disease condition?	100%	No
4 Do you believe that this disease is your fate or an inevitable condition?	50%	No
5 Are you disgusted or frustrated with your life as a result of this disease condition?	100%	No
6 Do you feel sorry for yourself when you see person hale and hearty?	100%	No
7 Do you have any fear that this disease will worsen further?	100%	No
8 Do you have any fear that you would become disabled for long?	100%	No
9 Have you required to design or choose clothes, especially to suit you as a result of this disease?	50%	No
10 How much this disease is troublesome to you when considering your health and other issues?	100%	No
11 Do you have worries that other members of your family will get infected with this illness through you?	100%	No
12 Do you try to keep this diseased condition as a secret from the others?	100%	No
13 Do you feel ashamed whenever your neighbours see your diseased condition?	100%	No
14 Do you think your family members will feel ashamed as a result of your diseased condition?	100%	No
15 Do you have difficulties in sitting or standing due to this diseased condition?	100%	No
16 Do you suffer from intermittent fever as a result of this disease condition?	100%	No
17 Do you suffer from pain as a result of this disease condition?	100%	No
18 Do you get satisfaction, relief by chatting and keeping company with your friends?	25%	Yes
19 Do you feel overburden with your day to day work?	50%	No
20 When you feel worried, do you get a consolation in reading books, newspapers or magazines?	25%	Yes
21 Do you feel that you are an inconvenience to others as a result of this disease?	25%	Yes
22 Do you feel reluctant to get treatment for your diseased condition?	25%	Yes
23 Do you feel relieved considering that there are patients with more severe disease than you?	25%	Yes
24 Do you feel calm by involving in religious activities whenever you feel troubled by this diseased condition?	25%	Yes
25 When you feel worried, do you get comfort by watching television?	25%	Yes
26 How do you feel the way your family members treat you?	25%	Yes
27 Do you suffer more from other illnesses than this disease condition? (E.g., Diabetes, Hypertension)	25%	Yes
28 Do you often think and sob about your illness?	25%	Yes
29 Do you blame yourself or anyone else about your illness?	25%	Yes
30 Are you conversing with your family or friends about your illness?	25%	Yes
31 Do you feel uncomfortable during sexual activities as a result of this disease condition?	50%	No

Table 3: Results of factor analysis on 15 attributes and its four dimensions (n=92)

	Factor*			
	Social	Physical	Fear	Humiliation
01. Has your diseased condition affected adversely to your day to day activities?	0.714	-	-	-
02. Do you experience any discomfort during travelling as a result of this disease condition?	0.771	-	-	-
03. Do you get the assistance of the others in attending to your work as a result of this disease condition?	0.775	-	-	-
04. Are you disgusted or frustrated with your life as a result of this disease condition?	-	-	0.810	-
05. Do you feel sorry for yourself when you see person hale and hearty?	-	-	0.672	-
06. Do you have any fear that this disease will worsen further?	-	-	0.550	-
07. Do you have any fear that you would become disabled for long?	-	-	0.662	-
08. How much this disease is troublesome to you when considering your health and other issues?	0.443 [‡]	-	-	-
09. Do you have worries that other members of your family will get infected with this illness through you?	0.423 [‡]	-	-	-
10. Do you try to keep this diseased condition as a secret from the others?	-	-	-	0.727
11. Do you feel ashamed whenever your neighbours see your diseased condition?	-	-	-	0.666
12. Do you think your family members will feel ashamed as a result of your diseased condition?	-	-	-	0.727
13. Do you have difficulties in sitting or standing due to this diseased condition?	-	0.808	-	-
14. Do you suffer from intermittent fever as a result of this disease condition?	-	0.806	-	-
15. Do you suffer from pain as a result of this disease condition?	-	0.593	-	-
Initial Eigenvalues	4.694	1.696	1.358	1.133
% of Variance	31.3	11.3	9.1	7.6
Cumulative %	31.3	42.6	51.7	59.2
Communalities	0.691	0.586	0.492	0.421
Reliability coefficient (Alpha)	0.831	0.765	0.702	0.649

*Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization; Rotation converged in 6 iterations.
Only co-efficient values >0.420 are displayed in table 3.

[‡] Complex questions; The best factor had been described by the experts.

Reduction of attributes and finalising response scale

Cronbach’s alpha was 0.765 (n=90) for the questionnaire of 27 attributes. Had nine (09) attributes were removed, the Cronbach’s alpha was greatly improved. Removal of another three (03) attributes would not have changed Cronbach’s alpha. Considering all these facts, a final questionnaire with 15 attributes was constructed. The response scale was modified as (a) not at all (b) sometimes (c) usually (d) on most occasions (e) every time/ always, to suit to all 15 attributes.

Factor analysis

Kaiser-Meyer-Olkin Measure of sampling adequacy was 0.832. Bartlett’s Test of Sphericity was $\chi^2 = 391.9$; $df = 105$; $p < 0.0001$. Four (04) factors have been extracted from the data in factor analysis of the 15 attributes (Table 3).

All factors identified in conjunction, accounted for 59.2% of the variance explained, the first factor had a variance explained of 31.3%, second of 11.3%, third of 9.1% and 7.6% for the fourth factor. The remaining eleven (11) factors had less than 5% of variance explained. The first factor consists of five (05) attributes, and others have 3 to 4 attributes. Item allocation to four factors was done when the item load was above 0.40. However, two attributes had recorded item load ≥ 0.40 in more than one-factor (Table 3). Experts described those complex attributes under a most suitable factor. None of the attributes were removed after factor analysis.

The analysis of PSB-CL questionnaire scores and its dimensions in terms of age, sex etc. is out of the scope of this part of the study. However, mean Likert scores under each dimension had shown a quite large percentage (42% - 69%) of patients having problems under four dimensions described above (Figure 1).

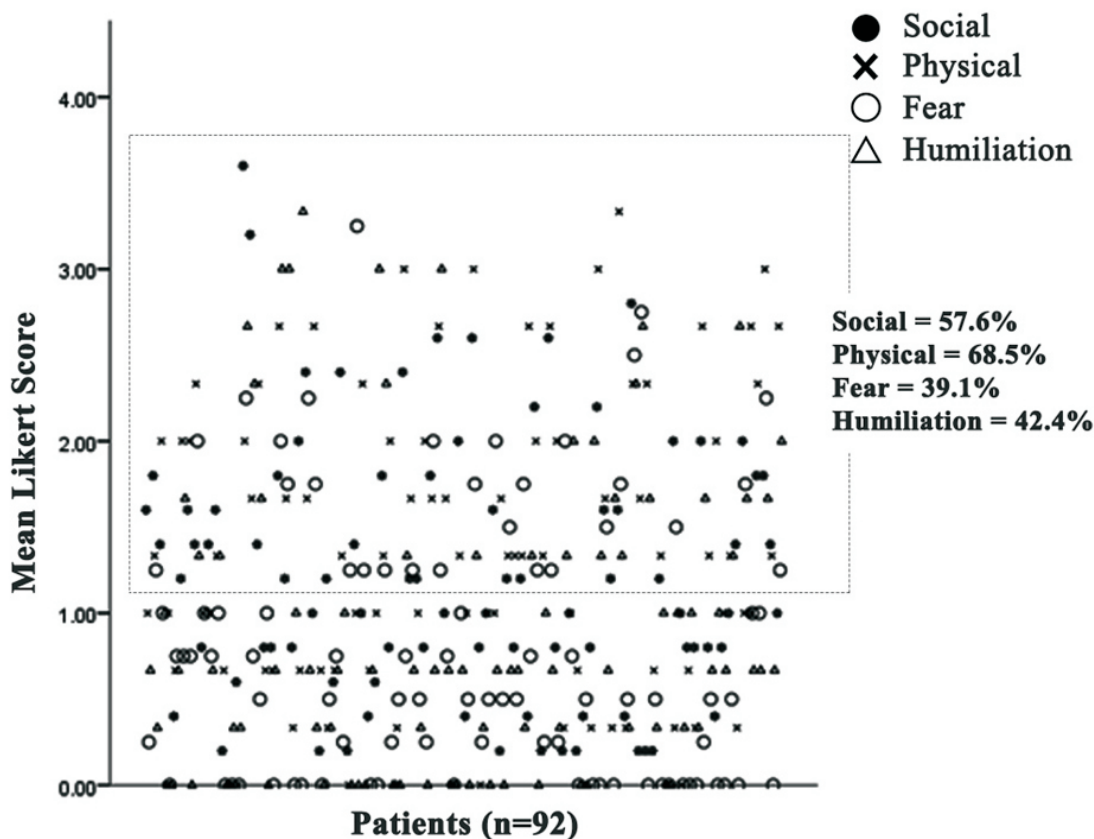


Figure 1: PSB-CL mean Likert score of four dimensions - Social, Physical, Fear and Humiliation (n=92)

Discussion

The newly developed health measurement scale, 15 item PSB-CL has shown promising results in the primary psychometric analysis (significant *internal consistency* Cronbach's $\alpha \geq 0.8$ and *factor analysis*-four meaningful dimensions). It will measure the psychosocial burden of chronic filarial lymphoedema patients in Southern Sri Lanka with significant validity and reliability.

There has been limited action to develop and test suitable scales to address the psychological aspect of LF in Sri Lanka. The national PELF had already implemented a programme MMDP to address the physical issues of LF morbidity. In the same MMDP programme, mental health aspects were addressed, but without proper guidelines. Therefore, development of a new tool to measure the psychosocial burden in LF patients in the country is an urgent need (17, 24). It was proposed that the use of support groups had a role in the lymphoedema management. Patient support groups in Haiti, and Dreyer's 'Hope Clubs' in Brazil have shown to improve the quality of life (QOL) among lymphoedema patients, also provide ongoing social and emotional support (12, 25).

In contrast, in the Sri Lankan study, many of the older interviewees would be willing to attend community gatherings with local lymphoedema patients to discuss their problems. However, the younger subjects wished to keep to themselves, and those who had difficulty in walking or standing were generally reluctant to participate at gatherings (11). Additionally, some patients in a recent qualitative study expressed that interviews themselves were a therapeutic release, which suggested that talking may be beneficial in some context (8). These suggestions revealed that psychological practices for one country might not be suitable in a different cultural context.

Three (03) important tools were identified; Disability Assessment Schedule 2.0 (WHODAS 2.0), the Dermatology Life Quality Index (DLQI), and the Lymphatic Filariasis Quality of Life Questionnaire (LFSQQ). DLQI was translated to Sinhala language and tested in samples of Sri Lankan populations (11, 20) however, noticed that the questionnaires were not covering the dimensions we were expecting. The Sinhala translation of

WHODAS 2.0 is currently used in one of our ongoing projects with multiple drawbacks. Therefore, the control of psychosocial burden associated with LF in national MMDP programme has been stalled due to non-availability of scientific scale to measure the burden (17). The initial approach to develop a specific scale to assess the psychosocial burden of LF patients through in-depth interviews with patients, has produced an unbiased environment to collect reliable information (19).

Forty-six (46) in-depth interviews were an adequate sample for a qualitative study. Well planned in-depth interviews assisted the interviewer, transcriber and translator to maintain the standards needed in the scale development process by preventing, even losing patient's vague expressions (26, 27). PSB-CL scale was developed using the methodology described in quality of life measurement scale development (19). However, in the psychometric analysis, we could not perform advanced analysis by using Classical Test Theory (CTT) and Item Response Theory (IRT) (Rasch analysis) due unavailability of software. We abled to do only principal component analysis with SPSS by producing significant results (Table 3). Thus, this PBS-CL scale promises to be a good tool to measure the psychosocial burden of LF patients, and appears to have psychometric properties at a reasonable level.

It is noteworthy that the patient's problems and suffering that arise from time to time cannot be measured with 100% accuracy by using a dimensional model. There is a clear distinction between cases and non-cases with categorical approach, but not with the dimensional (19). In the process of dimensional model development, loss of pieces of vital information is inevitable, and may have a considerable effect on the overall content and structure of the questionnaire. However, there are advantages in the dimensional approach over the categorical approach. In the categorical approach, it is difficult, especially in psychosocial assessments, to have more than one problem, but the dimensional approach does permit this; some problems may be present, present in a mild form, even problems can coexist (19).

The transformation of speaking language to a written language, and using this as a direct or indirect questionnaire may not be the best option to measure psychosocial problems in some patients. The psychological and social burden of people in a developing country is due to various reasons, and they are embedded in the population for a longer period (28). Unfortunately, the reasons are more complex and originated from various dimensions like economic problems, social conflicts and the thinking pattern derived from the culture and religion. Further, we observed that the other common diseases like diabetes, hypertension, eczemas, varicose veins etc. have caused psychosocial problems in LF patients and interfered with the LF related psychosocial burden.

The meaning lost in audio transcribing became an information barrier. According to the selected methodology, the patients' minor facial expressions of emotional gestures could not be documented during the interview (26, 27). Even though we tried to transcribe patients' emotional variation of voice, facial expressions and emotional body gestures, it was very difficult with audio recording methodology. However, the best possible representation and understanding of the interpreted experience of the participants and thereby validating qualitative research could overcome these issues to a certain extent (26).

Thus, in PSB-CL scale development process, careful selection of patients for in-depth interviews and item reduction techniques made the final questionnaire more stable and comprehensible. Explorative factor analysis and item analysis helped us to make a final version with meaningful and acceptable factors. The Sinhala questionnaire of PBS-CL has been translated into English by two independent translators for the publication purpose. We are in the process of validating the 15 item PSB-CL questionnaire. We need to use a bigger and representative sample before adopting it as a scale to monitor the psychosocial burden of patients in community settings.

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Maternal competencies among mothers with infants at early infancy in Sri Lanka; a qualitative evaluation

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ABSTRACT

Introduction: Maternal competencies among mothers with infants at early infancy are sparsely described in the literature. This study explores the dimensions of competencies among mothers with infants at early infancy in the Sri Lankan context.

Methods: An exploratory qualitative study was conducted using focus group discussions with mothers, fathers, and grandparents of infants aged up to 6 months and in-depth interviews with health personnel providing maternal and child health services for these mothers and infants. The Framework approach for qualitative data analysis was used to identify dimensions of parenting competencies in mothers at early infancy.

Results: Five dimensions of maternal parenting competencies were identified i.e.; feeding the infant, maintaining hygiene, dealing with crying, dealing with illnesses and recognizing the normal growth and development.

Conclusions: The findings can be used to develop culturally specific tools to assess the level of parenting competencies in mothers and to design maternal educational interventions to reinforce their parenting skills.

Keywords: *Early infancy, maternal competencies, parenting, qualitative study, Sri Lanka*

Introduction

The birth of a child is not only a time of change in the life of a family but also a critical event characterised by personal, marital and social reorganisation (1-3). Pregnancy, childbirth, and parenting are normal momentous life events for women and their families. Thus, childbirth and parenting are a major concern in maternal, child, and family healthcare.

Assessment of parenting competencies is very crucial to ensure the health and well-being of the child. It helps to understand the characteristics and patterns of a parent's functioning and child-rearing roles. Parenting competencies are defined as '*a set of knowledge, skills, and attitudes that facilitate and optimize the performance of the parental role with the necessary mastery to ensure the maximum*

potential for the child's growth and development' (4). According to the International Council of Nurses (5), parenting involves four dimensions: taking on responsibilities for the effective exercise of the role; optimizing the child's growth and development; incorporating the child into the family, and behaving according to the expected behaviours of being a mother and father. The mastery of parenting competencies influences how each parent interprets his or her behaviour and his or her child's behaviour (6). Therefore, the acquisition of knowledge and skills related to the child's needs are promoted with the acquisition and development of parenting competencies, with the subsequent improvement of confidence, satisfaction and mastery in-role performance (4).

The most rapid period of a child's growth and development or the "critical window" of life is considered as before birth and during the first two to three years of life (2). This period has the greatest impact on the child's future growth and development and is critical for setting the foundation for all later well-being (3). Studies reveal that all children need protection and care during the first months of life to support all aspects of their growth and development (physical, social, emotional, cognitive and spiritual) and parents are the best persons to provide such care with quality parenting competencies (7). The first few months of life or the early infancy have many dependency needs which include adequate feeding, adequate hydration, adequate cleaning, adequate shelter, and more specifically, keeping the body temperature within the narrow range, and warmth and affection (7). It was highlighted that the greatest number of dependency needs seem to be encompassed in early infancy, and dependency needs begin to change and decrease with age and maturity (8). Therefore, the acquisition of parenting competencies is crucial for parents with infants at early infancy.

The assessment and identification of care needs is the first step of any intervention (5). Hence, the assessment of the parenting competencies is a relevant dimension of maternal and child care plans by the service providers (4).

The Demographic and Health Survey, Sri Lanka, 2006/07 revealed that 6.4% of women had begun childbearing when they were teens (9). The reproductive health information database of the Family Health Bureau of the Ministry of Health, Sri Lanka, indicates that 6.5% of the total pregnancies registered during the year 2010 were teenage pregnancies (10). These teen parents face many social and economic problems related to parenting (11). Similarly, they may lack competencies in child-rearing (12).

In Sri Lanka, maternal education sessions on certain parenting competencies such as breastfeeding and maintaining the hygiene of the infant are conducted as a routine practice during pregnancy at the field Maternal and Child Health (MCH) clinics and during home visits in the antenatal and postnatal period by Public Health Midwife (PHM). However, a proper evaluation of the parenting competencies

of the mothers is not done by the MCH services to assess the effectiveness of these sessions and to identify the areas needing attention.

This study was designed to explore the perceptions of a group of parents, grandparents, and providers of maternal and child health care services regarding parenting competencies required by the mothers with infants at early infancy to identify main dimensions and specific knowledge and skills. The findings will be used as a preliminary step of developing a tool for assessing parenting competencies and will also be useful in designing parenting education interventions for new mothers to enhance their competencies.

Methods

This study was conducted as a preliminary step of a larger study aiming to develop and validate a culturally specific assessment instrument to assess the parenting competencies among mothers with infants at the early infancy period in Sri Lanka. To generate items for the instrument, an extensive exploration of various concerns on parenting competencies among mothers with infants at early infancy was conducted between September and December of 2017, using two qualitative methods; focus group discussions (FGD) and in-depth interviews (IDI).

FGDs were conducted with mothers, fathers, and grandparents of infants at the early infancy period registered in MCH clinics in Matara District, Sri Lanka. Matara district was selected as the study setting for FGDs to avoid data contamination during the main study that would be conducted in Galle district. IDIs were conducted with MCH care providers in two Teaching Hospitals, field MCH clinics, and a general practice in Galle District, Sri Lanka considering the convenience of conducting interviews at the familiar field to the principal investigator.

Participants for the FGDs were selected based on non-probability convenience sampling. Infants aged up to 6 months registered at the MCH clinics were identified and their parents and grandparents were recruited through public health staff by considering the eligibility criteria. Mothers who had given birth to multiple or pre-term babies and those having

physical or mental disabilities, mothers of infants with any medical or surgical complications at birth or afterward and those who require special care, mothers who live outside the Matara district and who attend the clinics only temporarily were excluded from the study. The mothers who cannot communicate in Sinhala (the medium used for FGD) were also excluded. A total of nine FGDs with eight participants per session were conducted with mothers, fathers, and grandparents (three FGDs per each group).

For IDIs, a pediatrician, a general practitioner, two Medical Officer of Health, two Public Health Nursing Sisters, two PHMs, and two senior nursing officers working in the pediatric and postnatal wards were selected and recruited based on service experiences with postnatal mothers and infants at early infancy. Service providers who had difficulty in assigning a time slot for IDIs due to busy schedules and those without a genuine interest to take part in the study were excluded.

Data collection was initiated after obtaining prior approval from the health authorities. Written informed consent was obtained from the participants after explaining the purpose of the study. FGDs were conducted by the principal investigator as the moderator and note-taking and audio recording were done by a trained research assistant. The discussions were conducted in a separate room at the local MCH clinics at a convenient time to ensure maximum participation. Each discussion lasted between 30 and 45 minutes. IDIs with service providers were conducted by the principal investigator at their respective workplaces after a prior appointment. Each interview lasted between 45 minutes to one hour and was audio recorded by the principal investigator.

A pre-tested guide with semi-structured and structured questions was used to preserve the uniformity of the FGDs and IDIs. Data were collected until the data saturation was achieved. A checklist was used in every session to maintain the completeness of the data collection procedure to enhance the quality of data collection. Only one session was conducted on a given day. After each session, participants were given a summary of the outstanding facts made and they were allowed to volunteer any additional information to obtain a more comprehensive view.

All the discussions were conducted in Sinhala language and notes were taken down during the interviews were completed in detail immediately afterward by the principal investigator to ensure the accuracy of information. FGD and IDI recordings were transcribed verbatim.

The Framework approach for qualitative data analysis (13) was employed in the analysis. Interview transcripts were transcribed verbatim and the research team got familiarised with the whole interview by re-listening to the recordings. The transcripts were read carefully to obtain a holistic impression and to identify the codes. The final set of codes was selected to form the analytical framework with the agreement of the research team. Subsequently, the data were charted and a matrix was developed manually, with the inclusion of illustrative quotations. The summarised data sheet was used to identify the characteristics and patterns of data concerning the experiences and perceptions of parenting competencies.

Ethical clearance was obtained from the Ethics Review Committee of the Faculty of Medicine, the University of Ruhuna, Sri Lanka (Reference No:19/12/2016:3.4). Participants were recruited voluntarily and were given the freedom to withdraw from the study or to refuse participation without prejudice. Informed written consent was obtained from all participants. Strict confidentiality of information was maintained and participants were identified using serial numbers and no names were mentioned in the notes or audio recordings. The study findings were presented in a generalised form.

Results

A total of 24 participants of mothers, fathers, and grandparents were included for FGDs, whereas 10 service providers were recruited for the IDIs.

Five themes emerged from the analysis describing five major dimensions of parenting competencies; namely, (1) feeding the infant, (2) maintaining hygiene, (3) dealing with crying, (4) dealing with illnesses and (5) recognising the normal growth and development. Verbatim quotes from the study participants are labeled as follows; mothers (Mo), fathers (Fa), grandparents (Gp) and service providers (Sp).

Theme 1. Feeding the infant

The study found that infant feeding is a mainstay among all the dimensions of parenting competencies required by mothers with infants at early infancy as infants are entirely dependent on the mother during this period. Breastfeeding was unanimously perceived as a major responsibility of the mothers.

“I know my child is depending on me until six months of age...” (Mo)

“It’s just important that I give my wife good food as she is always giving breast milk to my child...” (Fa)

“I can do anything for my grandchild except giving breast milk.....it’s a compulsory task of mothers.....” (Gp)

However, the lack of skills in breastfeeding may hamper this important task. In the service provider’s perspective, it was highlighted that the attachment of the infant to the breast is not practiced appropriately by the mothers which always results in feeding difficulties.

“Our mothers are always complaining of having no breast milk to feed the baby....but the problem is they are practicing poor feeding techniques...” (Sp)

Theme 2. Maintaining hygiene

Another main theme identified in this study was maintaining the hygiene of the infant including bathing the infant, washing the eyes and ears, hygiene of the perineum and care for the nails, which are viewed as utterly important aspects in parenting competencies. However, mothers often stated that they had no confidence to bathe the infant.

“I can do all the others, except bathing the baby....I feel fear to do that...” (Mo)

“My daughter never tries to bathe the baby...I’ve been bathing my grandson since his birth...” (Gp)

It was highlighted that the mothers are highly focused on maintaining the clean surroundings within the house and separate things used for the infant.

“I always keep the things used for my daughter separately like a basin, soap and other things...” (Mo)

According to the service provider’s point of view, the mothers maintain hygienic practices and they have a good sense that poor hygienic practices lead to illnesses.

“Mothers try to maintain the hygienic practices at an optimum level as they can...” (Sp)

Theme 3. Dealing with crying

Dealing with crying was also one of the parenting competency domains that emerged from the study.

According to the study, findings revealed that fathers are not satisfied with the mother’s competencies in dealing with a crying infant.

“Sometimes (I) feel angry with the wife... she can’t stop the baby from crying ...” (Fa)

“One day neighbors also came running to our home, when (they) heard continuous crying of the baby...” (Fa)

Mothers highlighted that they felt stressed during inconsolable crying of the infant and were completely depressed by feeling the discomfort of the infant.

“Really it’s the hardest thing for me.....my mother is the only person who can deal with the crying.... even at midnight....” (Mo)

“My daughter also cries sometimes when it is difficult to calm down her son....” (Gp)

Service providers also experienced the poor ability of mothers in dealing with the crying of the infant.

“Mothers always get backward when their infants cry.....always seeking help from others, never even trying” (Sp)

Theme 4. Dealing with illnesses

Dealing with illnesses, especially the management of fever at home and preventing dehydration was another highlighted competency area in the study. The study findings highlighted that seeking medical advice is the most certain decision of the mothers just after the appearance of any ill health condition in the infant.

“When I feel the child is not well, I just visit the Doctor for taking medicine” (Mo)

In contrast, some mothers had a good sense of prior home care when the infant is suffering from an illness.

“I have a thermometer at home and I can measure my baby’s body temperature... If she is having fever, immediately I start sponging the baby using water and go to take medicine...” (Mo)

However, the service providers’ perspectives indicated that some mothers had a poor sense of reporting the things that happened at home related to the illness of the child when they come to seek medical advice. It appears that this inability to report the features of illness accurately causes problems of interpreting the nature or severity of the illness.

“When I ask from the mother when her child got fever.... or how many times her child vomited... some mothers were not confident enough to give an exact response....” (Sp)

Theme 5. Recognising the normal growth and development

Recognising the normal growth and development was another parenting competency domain that emerged from the study. Many mothers willingly took part in monitoring their children’s growth.

“I always want to make sure that my baby is healthy and the baby is all right...” (Mo)

“Most of the mothers have a good insight to keep records in the Child Health Development Record.... (Sp)

However, mothers did not seem to possess the ability to interpret the information in the health records meaningfully. It was highlighted that most of the mothers had a tendency of comparing their child with others; especially children of their neighbors, relatives or friends, according to the service provider’s perspective. This leads to uncertainty in mothers as to whether the growth and development of their child is appropriate.

“Mothers always compare the child with a known child and come to us with a lot of complaints.... but the child is ok...” (Sp)

Discussion

This study explored different dimensions of parenting competencies among mothers with infants at early infancy based on the views and experiences of mothers, fathers, grandparents and service providers. The findings highlighted that there are different domains of competencies among mothers. Also, both mothers and significant others in their inner family circle seem to perceive at least five main dimensions of competencies that are required by these mothers; namely, feeding the infant, maintaining hygiene, dealing with crying, dealing with illnesses and recognising the normal growth and development.

In interpreting the findings it was highlighted that most of the study participants who were interviewed were concerned that feeding the infant and maintaining the hygiene are foremost competency pillars in maternal parenting competencies. Further, it was noted that dealing with crying, dealing with illnesses and recognising normal growth and development were remarkably diverting competency domains towards elders of the mother and professional caregivers. Other studies revealed that prevention of infection, thermal protection, resuscitation of the newborn with asphyxia, exclusive breastfeeding, care of the low birth weight babies and identification and appropriate referral of sick neonates are leading pedigrees concerning maternal competencies (14,15).

Another study found that the mother or caregiver is consistently responsive to the infants’ care, meeting the infants’ physical and psychological needs (3). As noted by Grover (7) protection (an environment that is safe from physical and emotional harm); good health (including safe water, hygiene); appropriate nutrition (including exclusive breastfeeding for the first six months), stimulation (opportunities to explore the world, express curiosity, engage in problem-solving) and language development (listening and responding) are important in describing the maternal parenting competencies.

The strengths of this study include the use of two different data collection techniques (FGD and IDI) with a wider circle of informants (mothers, fathers, grandparents, and senior community health and hospital staff). This approach facilitated the

assembly of knowledge on parenting competencies at early infancy with comprehensive insight from different perspectives. All the interviews and discussions were conducted by the same investigator to minimise observer bias, which was an additional advantage. However, excluding participants who could not speak Sinhalese may hinder the generalisability of findings, although its effect would be minimal as nearly all of the ethnic groups participated in the study were well-conversant in spoken Sinhalese. However, as the cultural expectations of parenting competencies may vary across geographical boundaries, the replication of this study in diverse settings may further enhance the comprehensiveness of exploration.

Our findings suggest that a proper evaluation of parenting competencies is a vital requirement within the maternal and child care services in Sri Lanka. Many countries use validated tools to assess the parenting competencies (4). However, in Sri Lanka, no validated tools are available to assess this important aspect of family health. The findings of this study can be used to develop culturally specific tools to assess the level of maternal competencies by the local health system as well as to design educational interventions to enhance such competencies among the new mothers.

Conclusions

The study findings reflect that the major pillars concerning maternal parenting competencies are; feeding the infant, maintaining hygiene, dealing with crying, dealing with illnesses, and recognising the normal growth and development. In justifying the sense of optimal reliability of these findings, development of a culturally specific parenting competency assessment tool unique to Sri Lanka may prove fruitful. Evidence-based decisions arising from such tools can be utilized in setting priorities and establishing effective strategies to enhance parenting competencies in the identified domains through appropriate interventions at national level.

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A brutal case of physical child abuse

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Introduction

The precise definition of child abuse varies from countries to cultures in given periods of time. However, in 1999, the World Health Organization formulated the following definition: “Child abuse or maltreatment constitutes all forms of physical and or emotional ill-treatment, sexual abuse, neglect or negligent treatment or commercial or other exploitation, resulting in actual or potential harm to the child's health, survival, development or dignity in the context of a relationship of responsibility, trust or power” (1). Further to that, the physical child abuse is defined as “That which results in actual or potential physical harm from an interaction or lack of an interaction, which is reasonably within the control of a parent or person in a position of responsibility, power or trust. There may be single or repeated incidents” (2).

Even though the act of child abuse has been a known occurrence throughout the history, it has become a significant social problem only in the recent past. According to United Nations International Children’s Emergency Fund (UNICEF, 2012) report on the epidemiology, more than one in four children worldwide have experienced severe and frequent physical abuse (3). According to some other studies, it is estimated that, nearly a quarter of adults (22.6%) have suffered physical abuse as a child, throughout the world (4). Approximately 2.9 million cases of child abuse are reported every year in the United States and the boys (48.5%) and girls (51.2%) become victims at nearly the same rate. It is assumed that in the United States, more than 4 children die from child abuse and neglect on a daily basis (5). According to

UNICEF, prevalence rate of child abuse in low and lower middle-income countries across the East Asia and Pacific regions is around 17-35% (5).

The actual incidence of child abuse in Sri Lanka is not known and it is known to vary from area to area. According to available literature, child abuse in Sri Lanka is a well-recognized social problem (4). According to a study done in the Northern Sri Lanka, 83.8% of the studied children reported a life time history of some form of abuse (6). In another study done in Sri Lanka, the overall prevalence of childhood physical abuse in the studied sample was 45.4% (4). In a study done in Southern province of Sri Lanka, prevalence of physical child abuse among male and female children were 22.4% and 15.7% respectively (7). Fernando & Karunasekera (2009) reported 44% physical abuse among the state university students during their childhood (8). According to statistics of the National Child Protection Authority of Sri Lanka, in 2019 they had received 2,342 complaints regarding cruelty to children (9). The case under discussion is an unfortunate event where a female child, who was handed over to a relative to look after and to send to school due to financial difficulties, was kept as a domestic servant and subsequently subjected to physical abuse.

Case presentation

An eight-year old girl, who was living with her aunt for the last three years, was admitted to a tertiary care hospital with a history of an accidental fall. She was living with her aunt due to financial difficulties faced by her family since her father

abandoned them. She was handed over to her aunt by her mother to be looked after and to be sent to school. As there were some unexplainable injuries present over the body and the incompatible nature of the history, she was referred for a medico-legal examination.

She was depressed in mood and not willing to communicate. On questioning, she initially mentioned about an accidental fall while climbing a tree. Once a rapport was developed, she revealed a totally different story. According to her, she was continuously being abused physically by her uncle during the last 3 years. She revealed that she was hanged by her wrists or ankles on the roof and then was beaten up with clubs and a cane. She also mentioned that sometimes her uncle used a hot iron rod and fire sticks to burn her back and limbs when she was caught playing outside with her cousins. Her genitals were burnt with a hot iron rod very recently because she wet her bed on sleep. She was lifted and thrown away at times causing fractures to her bones. Although the son and daughter of her aunt were sent to school, she was kept at home as a domestic servant. She had to do all the cleaning of the house as well as washing all the clothes. She was not given adequate food or clothing and her healthcare and well-being was found to be neglected. Even though she was not sexually abused by her uncle, she was repeatedly scolded and insulted both by her aunt and her uncle, subjecting her to a serious form of emotional abuse. She was threatened with abandonment, causing injury and even death by her uncle.

On examination, she was an averagely built moderately nourished girl without the development of secondary sexual characteristics. She had frozen awareness and eye avoidance. She had multiple oral hygienic issues. There were fresh, partially healed and old healed injuries over several parts of her body. Multiple fresh contusions were observed over the outer aspect of her right upper arm. Recent fractures were observed over mid shaft of the right femur and the left superior pubic rami of the pelvis (Figure 01). Traction were found to be applied over her right lower limb due to the fracture femur (Figure 02). Partially healed burn injuries were noted over her perineal area with the involvement of her external genitalia (Figure 03).

Her hymen was found to be intact with no evidence of sexual abuse. Healed abrasions were noted over the anterior and medial aspects of the left lower leg and ankle (Figure 04) and over the medial and lateral aspects of the left lower forearm. Multiple scarring due to healed burn injuries were noted over the back, front of the right thigh (Figure 05) and over the buttocks (Figure 06). Multiple partially healed and healed abrasions were noted over the abdomen (Figure 07) and over the back. Her injuries were attended accordingly and a multidisciplinary approach was made for further management. According to the Paediatrician, she was under-nourished and needed further treatment. According to the psychiatrist, she was depressed and needed further follow up. The fractures and soft tissue injuries were dealt with by the general surgeon and the Orthopaedic surgeon. Other than the fractures mentioned above, no other recent or old fractures were identified in the skeletal survey. A case conference was held with the participation of all stake holders to decide what should be done regarding the custody of the child. At the end, it was decided to hand over the child back to her mother once the legal procedures are over. The probation officers agreed to follow up the child and the divisional secretary's office agreed to provide the necessary facilities to start schooling for the child.



Figure 1: Fracture of the left superior pubic rami



Figure 2: Traction applied over right lower limb



Figure 3: Partially healed burns in the perineum

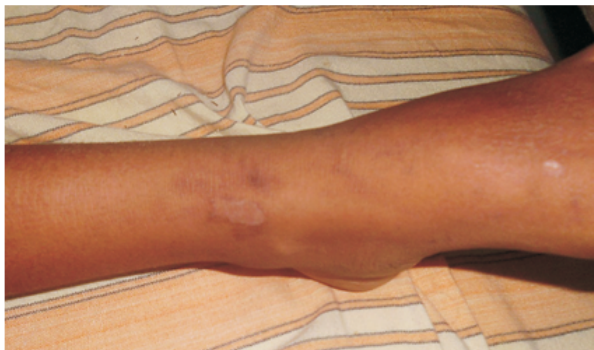


Figure 4: Healed abrasions over left lower leg and ankle



Figure 5: Healed burn injury over right thigh



Figure 6: Healed burn injuries over buttock



Figure 7: Partially healed and healed abrasions over the abdomen

Discussion

Childhood is usually considered as a time to be carefree, innovative and be happy. However, for thousands of children, this may not be true as violence has taken over their lives. It is believed that approximately 75% of the child abuse cases may be missed by the health care professionals due to their failure to recognize signs of abuse (10). This is critical in the management as this missed opportunity to intervene may lead to repeated abuse which may ultimately be fatal to the innocent victim. Some of the identified warning signs of physical abuse in children include; (i) frequent injuries or unexplained bruises, welts, or cuts (ii) being always watchful and on alert, as if waiting for something bad to happen (iii) injuries appear to have a pattern such as marks from a hand or belt (iv) shying away from touch, flinches at sudden movements, or seems afraid to go home (v) wearing inappropriate clothing to cover up injuries, such as long-sleeved shirts on hot days (10). In this instance, the health care workers were on alert to the unusual

pattern of injuries present and they have taken necessary actions to report it. This has led to the correct management of the child, with the handing over of the child's custody back to the mother.

Physical abuse maybe the result of deliberate attempt to hurt the child or to discipline the child (10). According to literature, most abusers are family members or those who are close to the family and the abuse by strangers are very rare (10). The usual perpetrator for physical child abuse is the parents followed by teachers (4). In a study done in Egypt, 37% reported being beaten or tied up by their parents (11). In another study done in Korea, 45% confirmed that they were beaten or whipped by their parents (12). In one of the recent studies conducted in Sri Lanka, only 3.4% were found to be physically abused by a male relative (4). As this case pointed out, even though the incidence is low, physical abuse by relatives do occur and a close attention is needed to prevent such activity.

The majority of children who are physically abused are younger than 3 years and the infants and preschoolers are supposed to be at a greater risk (8). It is believed that as a child ages, the risk of abuse decreases (7). In a study done in Northern Sri Lanka, children below 5 years of age were the commonest age group subjected to physical abuse (13). In the case discussed here, the victim was an eight-year-old girl. This is a good example for the fact that, irrespective of the age, children can face severe forms of physical abuse. According to literature, beating a child with an object such as cane or clubs were the commonest method used for physical abuse followed by hitting or punching (4,11). Burning with heated object was found to be as low as less than 2% (5,11). In this instance also, this child was repeatedly assaulted using a cane and clubs. Moreover, she was burnt several times using a heated iron rod and fire sticks, which is an uncommon occurrence according to literature.

Contusions are the most common type of injury present in the victims of physical abuse (11). Injuries due to sharp force are relatively rare. In this case also fresh contusions were identified over the outer aspect of the upper arm. No sharp force injuries were seen among the injuries present on her body. Injuries caused by burns are a recognised category in physical child abuse. It is estimated that

approximately 10% to 25% of pediatric burns result from abuse (14). The most common cause for childhood burns is scalds due to hot liquids followed by contact burns resulting from direct contact with a heated object (15). Inflicted contact burns tend to cause more sharply defined pattern with a recognizable shape whereas accidental contact burns tend to be less well demarcated, because of the reflex action of the child (15). In this instance, multiple clearly demarcated partially healed and healed burn injuries were identified over her buttock, thigh and perineum. The clearly demarcated patterns present were highly suggestive of deliberate application of a heated object. Multiple fractures or fractures in different stages of healing in a child always raise the possibility of an abuse (14). Metaphyseal lesions, posterior rib fractures, scapular fractures and fractures of spinous processes are some of the fractures which are highly suggestive of abuse (14). Fractures with a moderate specificity for abuse include epiphyseal separations, vertebral body fractures and subluxations, digital fractures, and complex skull fractures (14). In this instance, there were fractures involving the right femur shaft and the pelvis. Although the skeletal survey did not reveal any old fractures, presence of multiple fractures was highly suggestive of abuse.

Some of the injuries inflicted in physical child abuse may not be visible to the untrained eye. All regions of the body are needed to be thoroughly examined to avoid such mistakes. Obscure sites for inflicted injuries include the ears, especially the posterior aspects, the neck and angle of the jaw, scalp, and the frenula of the lip and tongue (14). In comparison to accidental injuries, inflicted injuries tend to occur in sites away from bony prominences such as neck, buttocks, trunk, hands and upper arm (14). In this case, no obscure injury was identified after a thorough examination. However, most of the injuries identified were present at sites away from bony prominences, such as buttock, indicating the possibility of physical abuse.

According to the right of children to free and compulsory education act, 2009 (16), every child of the age of six to fourteen years shall have the right to free and compulsory education in a neighborhood school till the completion of his or her elementary education. However, the upper limit

of compulsory education age was increased to sixteen years in the year 2016 (17). In this instance this child was not given education for the last 3 years, which was a clear violation of her rights. On the other hand, employment of women, young persons and children act (18), prohibits employment of children under the age of 14 years except in the following circumstances; by his parents or guardian in light agricultural or horticultural work or similar work carried on by members of the same family before the commencement of regular school hours or after the close of school hours. According to this act also, employing a child below 14 years for work depriving education rights is an offence. Therefore, other than physical child abuse, the assailants can be charged for two additional offences.

In conclusion, this child gave a history of assault with clubs and a cane after tying her wrists and ankles with a rope. Compatible injuries were observed over her wrists, ankles, abdomen and over her back. She also gave a history of repeated burning of her body with a heated iron rod and fire sticks. Compatible injury patterns were observed over her genitals, limbs and over the back. She had multiple long bone fractures and a pelvic fracture making her injuries grievous. Injuries found on her body were of different stages of healing ranging from very recent fresh injuries to old healed scars. This was a clear indication of the repeated abuse experienced by this girl over the past few years. Even though there were burns over her genitals, there was no evidence of sexual abuse. She was deprived of schooling and she was kept as a domestic servant, both of which are punishable offences together with physical child abuse. Although prevention of child abuse has been on focus among various professional groups, cases of this magnitude still surface from time to time. The awareness regarding these issues among the general public as well as the health care providers are the need of the day to minimise these unfortunate incidences in the future.

Written informed consent was obtained from the guardian for publication of this case report with photographs.

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The story of adult veno-venous extracorporeal membrane oxygenation (ECMO) in Sri Lanka; a case report of leptospirosis-associated severe pulmonary haemorrhagic syndrome (SPHS)

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Introduction

Successful extracorporeal membrane oxygenation (ECMO) in Sri Lanka was first reported in 2017 in a neonate in Galle (1). Galle is endemic to leptospirosis, one of the emerging infections with a high case fatality rate in Sri Lanka (2). The estimated annual caseload of leptospirosis in Sri Lanka from 2008 to 2015 was 10,423 (2). Recently, there have been reports describing the use of ECMO in adults with severe leptospirosis-related pulmonary involvement in the medical literature (3). Physicians in our institution, concerned with the escalating number of deaths, particularly in young, fit men having leptospirosis-related severe pulmonary haemorrhagic syndrome (SPHS), approached our ECMO team to discuss the possibility of using ECMO in such adults.

This is the first report of adult veno-venous ECMO performed in Sri Lanka. It illustrates how medical evidence, even in the form of sporadic case reports, combined with multidisciplinary discussion can save lives and bring about significant change in a medical system.

Case presentation

A 27-year-old, 55kg, previously healthy shopkeeper from Elpitiya was admitted to the local hospital with four days of fever, headache, arthralgia, myalgia and conjunctival suffusion. There was a history of contact with mud following the recent floods. He was transferred to Teaching Hospital Karapitiya, Galle with a clinical diagnosis of leptospirosis with

pulmonary haemorrhage for “plasmapheresis and further management”.

On admission, he was in severe respiratory distress with tachypnoea and an oxygen saturation (SaO₂) of 75%, and needed inotropes to maintain his blood pressure. A few hours later, he collapsed and was intubated and ventilated. There was bleeding into the endotracheal tube and bilateral consolidation with alveolar (cotton-wool) shadows on the chest radiograph, signifying pulmonary haemorrhage (Figure 1a).

He was prescribed intravenous C penicillin 2MU 6 hourly, ceftriaxone 1g 12 hourly, immunoglobulin 20g daily and methyl prednisolone 1g daily. Therapeutic plasma exchange (TPE) was commenced on the first day.

Over the next two days he became oliguric and thrombocytopenic but remained normokalaemic. There were T inversions on the inferolateral leads of the electrocardiogram, and mild global hypokinesia with 45-50% ejection fraction on the echocardiogram. The second cycle of TPE was done. The hypoxia and respiratory acidosis worsened despite high ventilator settings: Peak/mean inspiratory pressures 49/24mmHg; Positive End Expiratory Pressures 12mmHg; Fraction of inspired oxygen 100%. PaO₂ 58mmHg; pCO₂ 79mmHg; pH 7.2; bicarbonate 20mg/dl. The Murray score was four. At this point our ECMO team was contacted. Although eligible for ECMO, the only ECMO system available was already being used for a paediatric patient. As the adult was

rapidly deteriorating, a decision was made to use the back-up ECMO pump and console without the heater cooler and blender, which was left on the paediatric patient. As an adult pump head was not available, we used a re-sterilized one from our demonstration kit.

Informed assent was obtained from the relations. The patient was cannulated percutaneously using 20F drainage and 18F return cannulae (Figure 1b) in the left femoral and right internal jugular veins respectively and placed on veno-venous ECMO (Figure 2).

This allowed blood from the IVC to be drained out of the body, oxygenated by the oxygenator and pumped back via the centrifugal pump into the right atrium.

The patient stabilized over the next few hours: His pH improved to 7.4 with pCO₂ of 45mmHg; SaO₂ 88-90% with ECMO flows of approximately 4 L/min. The ventilator settings were gradually reduced to rest settings allowing the inotropes to be weaned off. Standard heparinisation protocols were followed with a target activated clotting time of 180 - 200 seconds.

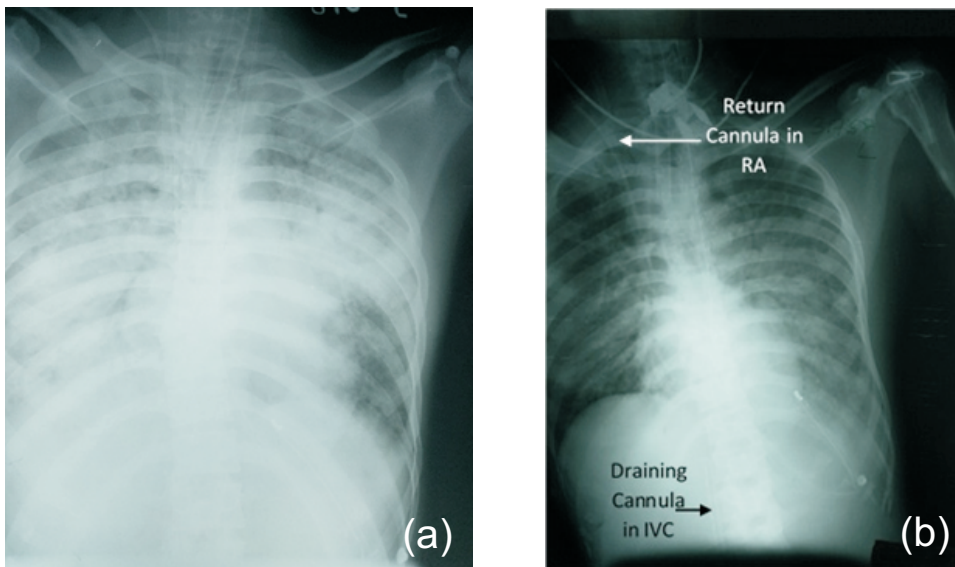


Figure 1: Chest radiographs at presentation (a) and after 10 days on ECMO (b)



Figure 2: Patient on a minimalistic ECMO circuit

The microscopic agglutination test (MAT), performed using the genus-specific Patoc strain, sent on the 6th day of illness became strongly positive. As the patient's respiratory and haemodynamic parameters remained stable, treatment continued with immunoglobulin, methylprednisolone and two more cycles of TPE. Nosocomial lung infection with multidrug resistant *Acinetobacter* and *Pseudomonas* species had set in needing intravenous imipenem 1g 8 hourly, teicoplanin 400 mg daily, nebulized amikacin 500 mg daily and oral doxycycline 100 mg 12 hourly over the next two weeks.

After 254 hours of ECMO, clinical and radiological parameters improved (Figure 1b) and he was weaned off ECMO successfully and decannulated. A tracheostomy was performed the next day. He was ventilated for 22 days and discharged from ICU after 30 days. His critical illness gradually resolved and neuropathy due to prolonged immobilization subsided to allow discharge five days later. At clinic review, he was well and described an out-of-body experience during the illness. Two years later, he remains well and fully functional.

Discussion

ECMO uses cardiopulmonary bypass technology in the intensive care setting. It is not a treatment but rather a support technique for cardio-respiratory function. This allows time for treatment (such as antibiotics, steroids, plasmapheresis) or simply the body's immunity to act in a patient who would otherwise not be alive.

The first successful ECMO in the world was performed in 1972, in an adult with acute respiratory distress syndrome due to trauma (4). Forty-five years later, the first adult ECMO in Sri Lanka was performed for leptospirosis-associated SPHS. Leptospirosis is not a common condition in the west where there is greater availability of ECMO than in the tropics where leptospirosis is endemic. Therefore, only a few case reports are available in the world literature as described by Arokianathan, *et al.* from Leicester (5), Umei, *et al.* from Tokyo (3) and Schmalzle, *et al.* from Hawaii (6), all showing the benefit of ECMO in leptospirosis. It was awareness of such reports that encouraged local Physicians to request Cardiothoracic Surgeons to extend their initial experience in neonatal ECMO to the adult arena. Today, ECMO is part of the therapeutic armamentarium for all age groups in

Sri Lanka and the final frontier in managing severe respiratory and/ or cardiac failure not amenable to conventional treatment.

Written informed consent was obtained from the patient for publication of this case report with photographs.

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Severe rhabdomyolysis without acute kidney injury in a female with acute dengue fever; an uncommon complication of a common disease

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Introduction

Dengue fever (DF) is an emerging public health challenge particularly in developing countries including Sri Lanka. According to World Health Organization (WHO), about 100 million cases estimated to occur annually, putting almost half of the world's population at risk in over 100 tropical and sub-tropical countries (1).

Dengue is an arbo-virus of family Flaviviridae and there are 4 serotypes of the virus that cause dengue (DEN-1, DEN-2, DEN-3 and DEN-4). Its main vector is *Aedes* mosquito species, commonly *A.aegypti* and *A.albopictus*. Dengue viral infection can cause unpredictable, diverse clinical syndromes from simple flu like illness through dengue haemorrhagic fever (DHF) and dengue shock syndrome (DSS) to unusual organic manifestations like encephalopathy, myocarditis, hepatitis, acute kidney injury etc. (2).

Myalgia is a common symptom in dengue viral infection, but myositis and rhabdomyolysis are uncommon in DF and only a few case reports have been published in literature. Most of dengue related rhabdomyolysis have been complicated with acute kidney injury (3). We describe the case of a 26-year-old Sri Lankan female who developed rhabdomyolysis without acute kidney injury following dengue virus infection.

Case presentation

A 26-year-old previously healthy female, from dengue endemic area (Galle, Sri Lanka), presented with acute febrile illness with arthralgia, myalgia,

and frontal headache, on the third day of illness. In addition, she also complained of severe back pain. She denied any exposure to suspect leptospirosis or typhus infections. Systemic inquiry was unremarkable. She has taken paracetamol 1g only when she developed fever and not taken any other regular medication or illicit drugs previously. There was no family history of inherited muscle disorders. She is a teetotaler.

On admission she was ill looking, febrile (102^oF) and flushed. Her haemodynamic parameters were normal. There was mild tenderness over proximal muscle groups of upper and lower limbs. Muscle power was normal. Her lower back was extremely tender on palpation. Her respiratory, cardiovascular and abdominal examinations were unremarkable.

Initial full blood count revealed leucopenia and thrombocytopenia. Non-structural protein 1 antigen of dengue (NS1) was positive. On the next day, markedly elevated aminotransferases and creatine kinase (CK) were found, but liver functions and renal functions were within normal range (Table 1). Her urine was brown in color and positive for myoglobin. There were no red cells in urine on microscopic examination. Peripheral blood picture showed evidence of viral infection without haemolysis.

She was assessed every three hourly for haemodynamic parameters and urine output. She was given 125ml of fluid per hour (oral and Intravenous) with vigilance of fluid overload which was not apparent. During hospital stay her haemodynamic parameters did not deteriorate, haemoglobin and PCV were stable. Serial bed side focus ultrasonography did not reveal any features of fluid leakage.

Table 1: Summary of investigations

	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 15
WBC (x 10 ³ /μL)	2.6	3.92	4.48	6.99	7.48	7.7	7.66
SK (μmol/L)	-	3.9	4.1	4.2	3.8	4.3	4.1
PT / INR	-	1.0	-	1.02	-	1.0	-
BIL (μmol/L)	-	2.6	-	6	-	4.3	-
HBG (g/dl)	14.5	13.3	12.9	12.8	11.9	12.6	12.6
SCR (μmol/L)	-	44	45	43	41	43	42
ALB (g/L)	-	36	-	34	-	33	-
PLT (x 10 ³ /μL)	115	92	103	125	147	154	253
ALT (U/L)	995	1023	1235	1392	1532	1482	269
AST (U/L)	3278	3863	3924	4970	5186	3499	101
LDH (U/L)	-	3522	4873		2477	1193	-
CK (U/L)	-	141960	242293	166339	92356	28183	1619

HBG; Haemoglobin, WBC; White blood cells, PLT; Platelets, AST; Aspartate aminotransferase, ALT; Alanine aminotransferase, PT/INR; Prothrombin time-international normalize ratio, ALB; Albumin, BIL; Bilirubin, LDH; Lactate dehydrogenase, CK; Creatine Kinase, SCR; Serum creatinine, SK; Serum Potassium

Her fever subsided on the fifth day after admission. The backache also improved permitting her to mobilize out of the bed. On the day six of illness IgM for dengue fever was also positive confirming the acute dengue viral infection. Throughout this period her urine output was satisfactory and renal functions were normal. Hepatitis B surface antigen (HBsAg), hepatitis C antibody and retroviral screening were negative. Serological test for leptospira was also negative.

She made a complete, uneventful recovery and was discharged from the hospital on day 8 of illness after assuring that transaminases and creatine kinase level coming down. She was advised to take more oral fluids and refrain from strenuous physical activity. One week after being discharged, her laboratory investigation showed further reduction of transaminases and CK.

Discussion

According WHO classification (4), diagnosis of dengue viral infection was firmly made in our patient who is from dengue endemic area and presented with acute febrile illness with arthralgia, myalgia, headache, leucopenia, thrombocytopenia and in

whom both the NS1 antigen and dengue specific IgM antibody become positive.

Dengue can associate with many neuromuscular complications. Muscle involvement in patients with dengue infection can manifest with myalgias, myositis, rhabdomyolysis, and hypokalaemic paralysis (5). Myalgia affecting back and proximal limb muscles is one of the characteristic symptoms in dengue fever, particularly in febrile phase, and usually self-limiting. Dengue-associated myositis can range from self-limiting mild muscle weakness to severe dengue myositis which may cause death (5).

Rhabdomyolysis, often characterised by diffuse myalgia, elevated muscle enzymes and myoglobinuria, is the most devastating muscular manifestation of dengue viral infection. It is more common in male and in patients with DHF (5, 6). Irrespective of CK level, it may be complicated with life threatening heme pigment-induced acute kidney injury (AKI) and associated electrolyte imbalances (7). AKI has developed with CK level 4,063 IU/L (8), as well as, 742,900 IU/L (9). Recent literature reviews have showed that most of the reported cases of dengue viral infection

with rhabdomyolysis has been complicated with AKI(3, 5).

Though the mechanism of muscle destruction in dengue viral infection is not very clear, it could be due to direct muscle invasion and replication of the virus and associated immune response (10). Huang, *et al* has also showed that interleukin-6 and tumour necrosis factor- α (TNF- α) levels were significantly increased in DHF with rhabdomyolysis than DHF without rhabdomyolysis in a small study (6).

A recent research in Taiwan has analysed 1,076 patients with dengue and found out that only 9 (0.84%) had rhabdomyolysis. Of those patients who have developed rhabdomyolysis, 6 had acute kidney injury (6). Analysis of those 9 patients with rhabdomyolysis in comparison to the patient, who has not developed rhabdomyolysis, showed that hypertension, myalgia, and acute kidney injury were independent risk factors for developing rhabdomyolysis.

Conclusions

We herewith report a previously healthy female with serologically proven dengue fever complicated with severe rhabdomyolysis who made uneventful recovery without acute kidney injury. We highlight the need for clinical suspicion of this rare complication in patients with dengue fever who develop severe myalgia especially back pain and involving proximal muscles. Timely suspicion and screening with serum creatinine kinase level would help clinicians to take measures to prevent subsequent acute kidney injury.

Written informed consent was obtained from the patient for publication of this case report.

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