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An enquiry based on a standardised questionnaire into knowledge, awareness and preferences concerning the care of familial hypercholesterolaemia among primary care physicians in the Asia-Pacific region: the "Ten Countries Study"

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ABSTRACT

Objective To determine physicians' knowledge, awareness and preferences regarding the care of familial hypercholesterolaemia (FH) in the Asia-Pacific region.

Setting A formal questionnaire was anonymously completed by physicians from different countries/regions in the Asia-Pacific. The survey sought responses relating to general familiarity, awareness of management guidelines, identification (clinical characteristics and lipid profile), prevalence and inheritance, extent of elevation in risk of cardiovascular disease (CVD) and practice on screening and treatment.

Participants Practising community physicians from Australia, Japan, Malaysia, South Korea, Philippines, Hong Kong, China, Vietnam and Taiwan were recruited to complete the questionnaire, with the UK as the international benchmark.

Primary outcome An assessment and comparison of the knowledge, awareness and preferences of FH among physicians in 10 different countries/regions.

Results 1078 physicians completed the questionnaire from the Asia-Pacific region; only 34% considered themselves to be familiar with FH. 72% correctly described FH and 65% identified the typical lipid profile, with a higher proportion of physicians from Japan and China selecting the correct FH definition and lipid profile compared with those from Vietnam and Philippines. However, less than half of the physician were aware of national or international management guidelines; this was significantly worse than physicians from the UK (35% vs 61%, p<0.001). Knowledge of prevalence (24%), inheritability (41%) and CVD risk (9%) of FH were also suboptimal. The majority of the physicians considered laboratory interpretative commenting as being useful (81%) and statin therapy as an appropriate cholesterol-lowering therapy (89%) for FH management.

Conclusions The study identified important gaps, which are readily addressable, in the awareness and knowledge of FH among physicians in the region. Implementation of country-specific guidelines and extensive work in FH education and awareness programmes are imperative to improve the care of FH in the region.

Strengths and limitations of this study

- The study is a large-scale multinational survey assessing familial hypercholesterolaemia (FH) knowledge and management gaps across 10 different countries/regions, with over 1000 physicians completing the questionnaire.
- The standardised questionnaire has been previously tested and employed in primary care in Australia and the UK.
- The self-selected group that responded to the questionnaire may reflect those with more interest and knowledge in lipid disorders.
- Since the survey was conducted anonymously, there was no specific information of responders and non-responders.
- The questionnaire employed did not cover all aspects of the care of FH, such as use of genetic testing and assessment of other cardiovascular risk factors.
- The analysis assumed that the primary care physicians from the UK were the gold-standard respondents.

INTRODUCTION

Familial hypercholesterolaemia (FH) is characterised by elevated low-density lipoprotein

cholesterol (LDL-C) levels owing to mutations in the low-density lipoprotein receptor (LDLr) pathway. FH is the most common inherited lipid disorder that accelerates atherosclerotic cardiovascular disease (CVD). However, the majority of people with FH are undiagnosed and undertreated.[1] FH is a public health problem throughout the world. The prevalence of heterozygous FH is estimated to be 1 in 200 to 1 in 500[2–6] in unselected community populations, with an estimated 3.6 million individuals in the Asia-Pacific region alone[7] and less than 1% are considered to be formally diagnosed in the region.[8 9] FH healthcare in the region leaves much to be desired.

Primary care physicians (PCPs) or family doctors are well placed in the community to opportunistically detect FH[10 11] and need to be involved in the care of these patients. The role of primary care in the care of FH has not been adequately defined, and our preliminary data suggest a significant shortfall in knowledge and awareness among family doctors.[7 12] As part of the 'Ten Countries Study',[13] we investigated several aspects of the knowledge, awareness and preferences of FH among PCPs in 10 countries/regions, primarily in the Asia-Pacific Region.

METHODS

The methodology for the present study has been previously described as part of the overarching 'Ten Countries Study',[13] a project investigating several aspects of the care of FH. The UK, a country with a highly developed healthcare system and a sophisticated guideline for the care of FH developed by the National Institute for Health and Care Excellence (NICE),[14] was included to provide the international benchmark. Since this was an anonymous quality assurance enquiry into clinical practice, formal ethics approval was not required and this was verified by the local ethics committee.

In brief, a formal questionnaire was offered to PCPs via cardiovascular education sessions, conferences and/or mail lists from the country-equivalent Royal Colleges. Language-specific versions of the questionnaire were developed from the English-language version via standardised back-translation techniques and the aid of bilingual translators. The survey inquired about the following aspects of FH: familiarity with the condition, awareness of national and international guidelines for FH; the clinical description of FH; identification of the typical lipid profile; prevalence and inheritance of FH; extent of elevation in risk of CVD, whether the diagnosis requires genetic confirmation; methods for alerting PCPs about the possibility of FH; type of health professional best placed to detect FH; number of patients with FH currently being treated; specific treatments; knowledge and practices concerning family screening and treatment and referral practices regarding patients with severely elevated cholesterol. Demographic data were also recorded.

Between March 2014 and August 2016, the survey was completed voluntarily and anonymously among physicians in nine countries and/or regions in Asia-Pacific (Australia, Japan, Malaysia, South Korea, Philippines, Hong Kong, China, Vietnam and Taiwan), as well as the UK.[15] Results from the PCPs surveyed in the UK have been published[15]; the details of the survey are available in the online supplementary file 1. Data were analysed using STATA V.12. χ^2 tests were performed to compare the Asia-Pacific PCPs to the UK. The survey responses from each country/region was compared with the UK as the reference group. The differences were investigated using logistic regression analyses. Significance was defined at the 5% level.

RESULTS

One thousand three hundred and thirty-five physicians completed the questionnaire; 257 physicians declared themselves to be specialist physicians and were excluded from the study. One thousand and seventy-eight PCPs from Australia (n=151), Japan (n=197), Malaysia (n=219), South Korea (n=97), Philippines (n=62), Hong Kong (n=59), China (n=118), Vietnam (n=137) and Taiwan (n=38) were included in the study. Fifty-four per cent of the respondents were male. There were a greater proportion of male respondents from Japan (84%) and South Korea (81%) compared with Malaysia (24%) and the Philippines (37%). Overall, practice location was spread over urban/metropolitan (63%), suburban/outer metropolitan (17%) and rural (20%) areas. Respondents from Hong Kong and Taiwan were all based in urban/metropolitan areas, possibly owing to the small size of their regions (<40 000 km^2). Table 1 details the demographics of the PCPs from the individual countries/regions and their knowledge, awareness and preferences regarding FH. One hundred PCPs from the UK were the comparator group.

A third of PCPs from Asia-Pacific rated their familiarity with FH as above average (>4, from a scale of 1 to 7). Although self-perceived familiarity with FH was not significantly different among most countries (except lower in Japan and China) and the UK, awareness of FH guidelines was significantly lower in Asia-Pacific compared with the UK (35% vs 61%, p<0.001). Similarly, the awareness of lipid specialists for referral or medical advice was significantly lower in Asia-Pacific compared with the UK (35% vs 50%, p=0.003); only Australian and Taiwanese PCPs were comparably aware. Regarding the knowledge of FH, PCPs from the UK were significantly better at selecting the correct FH description (89% vs 72%, p=0.001) compared with the Asia-Pacific PCPs.

Table 2 details the comparison of PCP's responses to questions about FH awareness, knowledge, practices and preferences with the UK as the reference group. In spite of the lower self-perceived familiarity with FH, Japanese and Chinese physicians were significantly better at identifying the correct FH lipid profile, compared with the UK. The response to questions concerning the prevalence, inheritance and CVD risk of FH were suboptimal

Table 1 Summary of primary care physician's (PCP) demographics and responses to questions (%) about awareness, knowledge, practices and preferences regarding familial hypercholesterolaemia (FH) in '10 countries'

Country/region	Australia	Japan	Malaysia	South Korea	Philippines	Hong Kong	China	Vietnam	Taiwan	UK[15]
Number of PCPs	151	197	219	97	62	59	118	137	38	100
Demographics										
Male	62%	84%	24%	81%	37%	53%	42%	46%	74%	42%
Urban/metropolitan	52%	49%	63%	82%	63%	100%	82%	40%	100%	47%
Suburban/outer metropolitan	33%	30%	0%	14%	15%	0%	18%	27%	0%	44%
Rural	16%	21%	37%	4%	23%	0%	0%	33%	0%	9%
Awareness										
Familiarity of FH rated as above average	32%	23%	38%	28%	34%	50%	23%	49%	47%	39%
Awareness about FH guidelines	36%	47%	35%	34%	N/A	43%	8%	28%	53%	61%
Awareness about lipid specialists	51%	33%	34%	30%	31%	40%	12%	39%	57%	50%
Knowledge										
Correctly described FH	72%	77%	86%	51%	73%	62%	75%	65%	60%	89%
Correctly identified lipid profile	59%	85%	65%	57%	48%	51%	85%	45%	61%	74%
Correctly identified prevalence of FH in the community	26%	41%	24%	19%	16%	11%	17%	14%	30%	30%
Correctly identified the transmission rate of FH to first-degree relatives	44%	40%	49%	42%	37%	49%	36%	26%	61%	51%
Correctly identified the cardiovascular disease risk in untreated patients with FH	14%	13%	9%	8%	10%	7%	4%	2%	5%	14%
Correctly identified that genetic testing was not required to accurately diagnose FH	50%	52%	47%	64%	68%	38%	38%	58%	24%	52%
Selected statins to best treat hypercholesterolaemia	89%	85%	96%	90%	95%	93%	95%	75%	95%	94%
Selected a combination of statin and ezetimibe to treat severe hypercholesterolaemia	64%	48%	56%	70%	48%	49%	77%	31%	63%	50%
Practice										
Screened patients with premature coronary artery disease for family history	93%	83%	95%	89%	92%	95%	94%	85%	95%	90%
Performed routine family screening of patients with FH (if there were patients with FH under their care)	86%	30%	82%	50%	53%	90%	47%	83%	77%	73%
The most prevalent age for screening young people in a kindred with FH was 13–18 years, which was selected by	52%	18%	52%	54%	52%	48%	16%	33%	20%	45%
Have referred patients with FH to a lipid specialists (if aware of lipid specialist)	66%	26%	52%	57%	32%	86%	86%	49%	100%	72%
Preference										
Selected PCPs as the most effective healthcare provider for the early detection of FH	80%	45%	92%	71%	58%	76%	8%	23%	50%	82%
Selected interpretive commenting on lipid profiles to highlight patients at risk of FH	89%	57%	92%	84%	92%	85%	86%	72%	89%	88%

Table 2 Comparison of primary care physicians' (PCP) responses to questions about familial hypercholesterolaemia (FH) awareness, knowledge, practices and preferences with the UK as the reference group using logistic regression analyses; OR (95% CI) shown

Country/region	Australia	Japan	Malaysia	South Korea	Philippines	Hong Kong	China	Vietnam	Taiwan
Awareness									
Familiarity of FH rated as above average	0.73 (0.43 to 1.24)	0.47 (0.28 to 0.79)*	0.95 (0.58 to 1.55)	0.61 (0.33 to 1.11)	0.80 (0.41 to 1.55)	1.56 (0.81 to 3.01)	0.46 (0.25 to 0.83)*	1.52 (0.90 to 2.57)	1.41 (0.66 to 2.99)
Awareness about FH guidelines	0.34 (0.21 to 0.61)**	0.58 (0.36 to 0.95)*	0.35 (0.22 to 0.58)**	0.34 (0.19 to 0.61)**	N/A	0.49 (0.26 to 0.95)*	0.05 (0.02 to 0.12)**	0.25 (0.14 to 0.43)**	0.72 (0.34 to 1.53)
Awareness about lipid specialists	1.03 (0.62 to 1.71)	0.5 (0.30 to 0.82)*	0.51 (0.31 to 0.83)*	0.43 (0.24 to 0.78)*	0.44 (0.23 to 0.86)*	0.68 (0.35 to 1.31)	0.14 (0.07 to 0.27)**	0.64 (0.37 to 1.11)	1.33 (0.61 to 2.90)
Knowledge									
Correctly described FH	0.33 (0.16 to 0.68)*	0.42 (0.21 to 0.86)*	0.78 (0.37 to 1.62)	0.13 (0.06 to 0.28)**	0.34 (0.15 to 0.78)*	0.21 (0.09 to 0.48)**	0.38 (0.18 to 0.82)*	0.24 (0.12 to 0.50)**	0.19 (0.07 to 0.50)*
Correctly identified lipid profile	0.52 (0.30 to 0.90)*	2.06 (1.12 to 3.77)*	0.65 (0.38 to 1.10)	0.47 (0.26 to 0.85)*	0.33 (0.17 to 0.65)*	0.37 (0.18 to 0.65)*	2.07 (1.05 to 4.10)*	0.29 (0.16 to 0.51)**	0.55 (0.25 to 1.20)
Correctly identified prevalence of FH in the community	0.80 (0.46 to 1.41)	1.60 (0.96 to 2.69)	0.73 (0.43 to 1.25)	0.54 (0.27 to 1.06)	0.44 (0.20 to 0.99)	0.28 (0.11 to 0.71)*	0.49 (0.25 to 0.93)*	0.38 (0.20 to 0.73)*	0.97 (0.43 to 2.22)
Correctly identified the transmission rate of FH to first-degree relatives	0.74 (0.44 to 1.23)	0.63 (0.39 to 1.03)	0.91 (0.56 to 1.48)	0.70 (0.38 to 1.27)	0.57 (0.30 to 1.08)	0.92 (0.46 to 1.84)	0.54 (0.31 to 0.93)*	0.34 (0.19 to 0.59)**	1.52 (0.68 to 3.46)
Correctly identified the cardiovascular disease risk in untreated patients with FH	0.97 (0.46 to 2.02)	0.90 (0.44 to 1.83)	0.59 (0.28 to 1.22)	0.56 (0.22 to 1.40)	0.66 (0.24 to 1.81)	0.46 (0.14 to 1.48)	0.28 (0.10 to 0.81)*	0.15 (0.04 to 0.52)*	0.34 (0.07 to 1.58)
Correctly identified that genetic testing was not required to accurately diagnose FH	0.91 (0.55 to 1.51)	1.00 (0.61 to 1.62)	0.83 (0.51 to 1.33)	1.63 (0.92 to 2.90)	1.94 (1.00 to 3.76)	0.56 (0.29 to 1.09)	0.56 (0.33 to 0.97)*	1.28 (0.76 to 2.17)	0.30 (0.13 to 0.96)*
Selected statins to best treat hypercholesterolaemia	0.50 (0.19 to 1.32)	0.37 (0.15 to 0.92)*	1.68 (0.57 to 4.99)	0.56 (0.19 to 1.59)	1.26 (0.30 to 5.21)	0.88 (0.24 to 3.25)	1.19 (0.37 to 3.82)	0.19 (0.08 to 0.48)*	0.74 (0.18 to 3.14)
Selected a combination of statin and ezetimibe to treat severe hypercholesterolaemia	1.75 (1.04 to 2.92)*	0.91 (0.56 to 1.48)	1.26 (0.78 to 2.02)	2.34 (1.31 to 4.21)*	0.94 (0.50 to 1.77)	0.97 (0.51 to 1.84)	3.37 (1.88 to 6.03)**	0.46 (0.27 to 0.78)*	1.71 (0.80 to 3.69)
Practice									
Screened patients with premature coronary artery disease for family history	1.57 (0.63 to 3.91)	0.53 (0.25 to 1.23)	2.10 (0.86 to 5.12)	0.87 (0.35 to 2.15)	1.27 (0.41 to 3.90)	2.07 (0.55 to 7.86)	1.76 (0.65 to 4.81)	0.61 (0.28 to 1.37)	2.00 (0.42 to 9.58)
Performed routine family screening of patients with FH (if there were patients with FH under their care)	2.25 (0.81 to 6.22)	0.16 (0.06 to 0.40)**	1.75 (0.65 to 4.70)	0.38 (0.14 to 1.04)	0.43 (0.17 to 1.06)	3.38 (0.93 to 12.21)	0.34 (0.10 to 1.10)	1.88 (0.34 to 10.27)	1.23 (0.39 to 3.86)
Selected 13–18 years as most appropriate for screening young people in a kindred with FH	1.32 (0.79 to 2.21)	0.27 (0.16 to 0.47)**	1.30 (0.81 to 2.10)	1.42 (0.81 to 2.51)	1.28 (0.68 to 2.42)	1.12 (0.58 to 2.15)	0.23 (0.12 to 0.43)**	0.59 (0.34 to 1.02)	0.30 (0.12 to 0.75)*
Have referred patients with FH to a lipid specialists (if aware of lipid specialist)	0.75 (0.34 to 1.64)	0.14 (0.06 to 0.32)**	0.42 (0.20 to 0.91)*	0.52 (0.20 to 1.37)	0.18 (0.06 to 0.57)*	2.33 (0.59 to 9.18)	2.33(0.46 to 11.78)	0.37 (0.15 to 0.88)*	1
Preference									
Selected PCPs as the most effective healthcare provider for the early detection of FH	0.89 (0.46 to 1.69)	0.18 (0.10 to 0.32)**	2.61 (1.28 to 5.31)*	0.54 (0.28 to 1.06)	0.30 (0.15 to 0.62)*	0.71 (0.32 to 1.55)	0.02 (0.01 to 0.05)**	0.07 (0.04 to 0.13)**	0.22 (0.10 to 0.50)**
Selected interpretive commenting on lipid profiles to highlight patients at risk of FH	1.15 (0.52 to 2.55)	0.18 (0.09 to 0.35)*	1.52 (0.70 to 3.30)**	0.69 (0.31 to 1.55)	1.55 (0.52 to 4.65)	0.76 (0.30 to 1.92)	0.81 (0.37 to 1.79)	0.36 (0.17 to 0.72)*	1.16 (0.35 to 3.84)

*p<0.05, **p<0.001.
N/A, question was not asked.
Pink significantly less than the UK.
Blue significantly more than the UK.

in all countries/regions, and particularly in China and Vietnam. Half of the PCPs correctly identified that genetic testing was not required to accurately diagnose FH. The majority of PCPs selected statins as the best pharmacotherapy to best treat hypercholesterolaemia, with a significantly lower proportion of PCPs selecting this from Japan and Vietnam, compared with the UK. Half of the PCPs selected the combination of statin and ezetimibe to treat severe hypercholesterolaemia, with a significantly higher proportion of PCPs selecting this from Australia, South Korea and China, compared with the UK.

Concerning practices relating to FH, PCPs from the Asia-Pacific region and the UK were equally likely to screen patients with premature coronary artery disease (CAD) for their family history of CVD. Of PCPs who had patients with FH under their care, 66% from Asia-Pacific and 73% the UK responded that they would perform routine screening of their family members and there was no significant difference. However, Japanese PCPs caring for patients with FH were the lowest who would undertake family screening among the countries/regions. The most prevalent age for screening young people in a kindred with FH was selected at 13–18 years. Although awareness of lipid specialists were suboptimal, in PCPs that were aware of lipid specialists, only 56% had referred patients with FH to a lipid specialist in the Asia-Pacific region, compared with 72% in the UK which was significantly higher (p=0.028); Japan, Philippines, Vietnam and Malaysia were particularly low.

The majority of PCPs from the UK (82%) selected themselves as the most effective healthcare provider for the early detection of FH. However, the response was highly disparate in the Asia-Pacific region, with only 8% of responses from China and 23% from Vietnam identifying PCPs as the preferred healthcare provider for the early detection of FH. By contrast, 92% from Malaysia and 80% from Australia selected PCPs (table 1). Overall, cardiologists (38%), lipid specialists (36%) and endocrinologists (10%) were also selected by the PCPs from the Asia-Pacific. However, PCPs did not consider that there was a significant role for paediatricians, obstetricians/gynaecologists and/or nurses with cardiac training in the care of FH. The majority of PCPs selected an interpretive laboratory comment on lipid test report results as being useful in detecting FH.

DISCUSSION

Recent knowledge of the population frequency of FH suggests that it can be viewed as a public health problem. Strategies for improving early diagnosis and care of FH in the community requires adequate knowledge and appropriate practices concerning this condition. This study is the first survey to demonstrate significant gaps in knowledge and awareness of FH across several countries/regions in the Asia-Pacific and to identify important areas of deficit.

In the present study, the lack of awareness of guidelines and lipid specialists can be related to the lack of country-specific guidelines[16] on FH and the lack of physicians specifically trained and practising as lipid experts in the region. Although the UK performed significantly better on these questions compared with the countries/regions in the Asia-Pacific, the results were still suboptimal. Thirty-nine per cent were unaware of FH guidelines despite the fact that NICE guidelines for identifying FH were released 7–8 years ago, and 50% were not aware of a lipid specialist in spite of the efforts from Heart UK in mapping specialist lipid clinics and establishing an FH Intelligence Network. Lack of awareness of clinical services for lipid disorders may be because specialist services do not exist in their geographical area, particularly for PCPs practising in suburban and rural regions, which constituted 43% of the PCPs surveyed.

The PCPs were generally able to correctly define FH. However, knowledge of FH prevalence, heritability and risk of CVD were suboptimal. Three quarters of PCPs in the present study were not aware of the theoretical prevalence of FH of 1:500 (with 42% selecting 'don't know') and 91% were not aware of the >20-fold risk of CVD in untreated FH[17] (with 30% selecting 'don't know'). However, as demonstrated by recent studies, heterozygous FH may be more common than 1:500[2] and given the sparse prevalence data from the region and the exceptionally high prevalence reported in the Hokuriku district of Japan,[18] the true prevalence of FH in the region is undefined. Additionally, CVD risk could be approximately 10-fold[19] and the relative risk of CVD with FH also varies significantly by age. Taking this into account, 45% of respondents identified the prevalence as between 1:100 and 1:1000 and 60% selected CVD risk to be 5–20 times greater. Although still suboptimal, this at least indicates an understanding that the risk of CVD is high among patients with FH.

Knowledge and familiarity with lipid-lowering treatment was reassuring; most PCPs identified statins to best treat hypercholesterolaemia. A lower proportion of physicians from Japan and Vietnam selected statins, which may relate to the availability of alternative medication (eg, probucol) and the lack of access to statins in some regions. Owing to the severity of hypercholesterolaemia, most patients with FH will require additional therapy to reach treatment goals.[1] PCPs from China, South Korea and Australia were particularly good at selecting combination statin and ezetimibe therapy for treating severe hypercholesterolaemia. By contrast, selection of combination statin and ezetimibe therapy in Vietnam was low and this may relate to the lack of general access to pharmacotherapies.

PCPs are critical in achieving long-term treatment adherence and have a key role in recognising family history of premature CAD. An accurate family history is integral to both CVD risk assessment and the diagnosis of FH. Encouragingly, 90% of PCPs would take a detailed family history in patients with premature CAD. However,

there were gaps in cascade screening of close relatives, especially in Japan. Although the European guidelines suggest screening of children in an FH kindred from the age of 5 years[20] and NICE guidelines recommend screening children between 2 and 10 years, PCPs in the Asia-Pacific region considered that testing between 13 and 18 years of age was a more appropriate practice. Studies on cholesterol screening in US paediatricians raised concerns regarding conflicting guidelines on lipid screening and treatment practices[21] and half of the paediatricians were opposed to the use of lipid-lowering therapies in children.[21 22]

Differences in the choice of healthcare professional perceived as best suited for managing FH and family screening among the countries/regions may reflect different healthcare systems. In particular, 83% of Chinese PCPs considered that lipid specialists were better suited to manage FH. There was the view that cardiologists are well positioned to identify index cases with FH presenting with coronary events.[23 24] Similarly, endocrinologists were considered well placed to identify FH in a secondary prevention setting. Overall, respondents in the present study considered that PCPs were best situated to identify FH in the primary prevention setting. Few considered that there was a significant role for nurses. This differs from the Netherlands[25] where screening programmes have been conducted by nursing and/or allied health staff. Screening may also be undertaken in a non-medical context such as workplace and schools; this option was not specifically enquired for in the present survey. Further exploration of health services and systems are warranted to optimise country-specific clinical service models and integration of care.[1]

The majority of PCPs in the present study thought that interpretative commenting attached to the reports on lipid profiles in people at high-risk of FH would be useful. This mode of alerting could play a role in the detection and management of FH.[26] Electronic screening tools to retrospectively identify FH in general practices could also be useful; some preliminary work from the UK and Australia has demonstrated the potential to increase identification of FH via this method.[27–29] Other methods such as screening via the laboratory[30 31] and improving communication between the requesting physician and the chemical pathologist[32] may also be useful. Implementing these in service mode will require an integrated collaborative approach with local laboratories, pathologists and treating physicians.

Increased lipoprotein(a), smoking, hypertension and diabetes are all known to compound CVD risk and are predictors of CAD in FH.[33–40] A limitation of the present survey was that CVD risk factors were not explored, particularly with the increasing prevalence of risk factors in Asia.[41] The use of genetic testing was also not explored. Other limitation of the study may be the self-selected group that responded to the questionnaire and may reflect those with more interest and knowledge in lipid disorders; the present study may not have captured the widest gaps in knowledge and awareness of FH. Since the survey was conducted anonymously, there was no recorded information on responders and non-responders. The analyses also assumed that the UK PCPs were the gold-standard responders and since the UK was the only country to administer the questionnaire via an online survey and mailing list, this may have biased responses. The generalisability of our results is constrained by the characteristics of the sample population. Extended enquires before and after education are required in the field. Given that primary care also involves other health professionals, such as practice nurses and allied health professionals, future studies should also be directed at these groups.

Similar surveys have been undertaken in PCPs[12] and pharmacists[42] in Western Australia, cardiologists in the USA[24] and physicians in India,[43] as well as a pilot study among physicians in Japan, South Korea, Taiwan.[7] Knowledge shortfalls were comparable, with underestimations of prevalence, heritability and CVD risk. A recent study by Schofield *et al*[44] assessed FH knowledge among a diverse group of healthcare professionals (including nurses and pharmacists in the UK) and demonstrated knowledge gaps in FH prevalence, diagnostic criteria and treatment options. In a smaller cohort (n=35) of healthcare professionals that completed a second survey following an FH education session, all aspects of FH knowledge was improved. Bell *et al*[45] have also shown that with direct education, PCPs are able to accurately assess FH. This emphasises the importance of investing in FH education programmes.[46] A global initiative, the European Atherosclerosis Society FH Studies Collaboration was launched with aims to disseminate information to empower the medical and lay community to seek changes to improve the care of patients and families with FH.[47] Education programmes in medical schools[48] and accredited courses with continuing professional development points could be useful. General media (newspaper, health magazines, television and radio), social media and patient support groups can be utilised to educate the lay community. The effectiveness of teaching and learning programmes require prospective audits and ultimately their impact needs to be gauged with defined outcomes in practices, such as the number of new cases of FH detected, commenced on statins and the proportion of all cases achieving guideline recommended LDL-targets.

Screening programmes in the region have been communicated by Singapore[49] and Hong Kong.[50] Owing to high population densities in the region, family cascade screening after the detection of an index case with FH could be particularly efficient and cost-effective. However, specific diagnostic criteria and guidelines in the region are only available from Australia,[51] Japan[52] and South Korea.[53] The Australasian model of care is a comprehensive clinical guideline encompassing elements of index case detection, diagnosis and assessment, management, cascade screening, genetic testing and the organisation of clinical services.[51] The Japanese criteria are based on the detection of tendon xanthomata,[52] which may only

be present in ~30% of patients with FH and particularly uncommon in the young,[54] and hence may have low sensitivity in screening and detecting FH. A study from South Korea demonstrated the lack of detection power with all conventional clinical criteria and suggested an LDL-C cut-off of 225 mg/dL (~5.8 mmol/L).[53] However, the LDL-C cut-off was derived from a biased sample of patients with existing hypercholesterolaemia. The lack of country-specific criteria may contribute to the lack of active screening programmes employed in the region and the cost of genetic testing in the community beyond research studies is not justified. FH research in the region is highly warranted; the mutation spectrum of FH is different from the European spectrum[55] and the mean cholesterol concentrations in most Asian countries are lower compared with Western countries.[16] Recent evidence from the USA indicating that pathogenic mutations in the LDLr pathway predicts CAD across a wide spectrum of plasma LDL-C levels implies that further enquiries could focus on the use and value of genetic testing in diagnosing and stratifying risk among patients with FH in the Asia-Pacific region.[17 56]

The integrated international guidance on FH,[1] endorsed by the Asian-Pacific Society of Atherosclerosis and Vascular Disease,[57] provides a foundation for developing country-specific guidelines, services and models of care. The principles are similar, but require the development of country-specific recommendations to screen, diagnose and treat FH, as well as strategies for long-term adherence and goal attainment.[58] Country-specific challenges in developing screening programmes may relate to their healthcare systems, as well as diverse cultures, political systems and economies[59 60] in the region. Challenges in treatment and management include the tolerability of statins, its availability and affordability[61] and its acceptability against the popularity of complementary and alternative medicines.[62 63] The FH 'Ten Countries Study' group is the first collaborative effort in the region focusing specifically on FH and should hopefully see the extension of the series of studies, including the present study, into the translation and transference of the research findings to country-specific models of cares.[13]

CONCLUSION

The present study identified substantial deficits in FH knowledge and awareness among physicians in the Asia-Pacific region, in particular, awareness of guidelines and knowledge of diagnostic features of FH. Knowledge of FH heritability, prevalence and CVD risk were also suboptimal. Major treatment gaps were identified in Vietnam and gaps in family screening were noted in Japan. However, through extensive FH education, awareness programmes and implementation of country-specific guidelines, these gaps can be addressed to accelerate the pace of FH diagnosis and treatment. Similar surveys are required in specialists practising coronary prevention in the region. A potentially effective method of standardising care across countries is participation in an international registry.[64]

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