Out-of-pocket payments for complementary medicine following cancer and the effect on financial outcomes in middle-income countries in southeast Asia: a prospective cohort study

*Yek-Ching Kong, Merel Kimman, ShriDevi Subramaniam, Cheng-Har Yip, Stephen Jan, Soe Aung, Mai Trong Khoa, Corazon A Ngelangel, Htun Lwin Nyein, Suleeporn Sangrajrang, Jitraporn Tanabodee, Nirmala Bhoo-Pathy, on behalf of the ACTION Study Group**

Summary

Background Complementary medicine, which refers to therapies that are not part of conventional medicine, comprising both evidence-based and non-evidence-based interventions, is increasingly used following a diagnosis of cancer. We aimed to investigate out-of-pocket spending patterns on complementary medicine and its association with adverse financial outcomes following cancer in middle-income countries in southeast Asia.

Methods In this prospective cohort study, data on newly diagnosed patients with cancer were derived from the ASEAN Costs in Oncology (ACTION) cohort study, a prospective longitudinal study in 47 centres located in eight countries in southeast Asia. The ACTION study measured household expenditures on complementary medicine in the immediate year after cancer diagnosis. Participants were given cost diaries at baseline to record illness-related payments that were directly incurred and not reimbursed by insurance over the 12-month period after study recruitment. We assessed incidence of financial catastrophe (out-of-pocket cancer-related costs ≥30% of annual household income), medical impoverishment (reduction in annual household income to below poverty line following subtraction of out-of-pocket cancer-related costs), and economic hardship (inability to make necessary household payments) at 1 year.

Findings Between March, 2012, and September, 2013, 9513 participants were recruited into the ACTION cohort study, of whom 4754 (50·0%) participants were included in this analysis. Out-of-pocket expenditures on complementary medicine were reported by 1233 households. These payments constituted 8·6% of the annual total out-of-pocket health costs in lower-middle-income countries and 42·9% in upper-middle-income countries. Expenditures on complementary medicine significantly increased risks of financial catastrophe (adjusted odds ratio 1·52 [95% CI 1·23–1·88]) and medical impoverishment (1·75 [1·36–2·24]) at 12 months in upper-middle-income countries only. However, the risks were significantly higher for economically disadvantaged households, irrespective of country income group.

Interpretation Integration of evidence-supported complementary therapies into mainstream cancer care, along with interventions to address use of non-evidence-based complementary medicine, might help alleviate any associated adverse financial impacts.

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*Group members listed at the end of the Article

Department of Social and Preventive Medicine, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia (Y-C Kong MPH, N Bhoo-Pathy MD); **Department of Clinical Epidemiology and Medical Technology Assessment, Maastricht University Medical Centre, Maastricht, Netherlands** (M Kimman PhD); **Centre for Clinical Epidemiology, Institute of Clinical Research, National Institutes of Health, Shah Alam, Malaysia** (S Subramaniam MMedSc); **Subang Jaya Medical Centre, Subang Jaya, Malaysia** (C-H Yip FCRS); **The George Institute for Global Health, University of New South Wales, Sydney, NSW, Australia** (S Jan PhD); **Sydney Medical School, University of Sydney, Sydney, NSW, Australia** (S Jan); **Oncology Society, Myanmar Medical Association, Yangon, Myanmar** (S Aung FRCP); **Bach Mai Hospital, Hanoi, Vietnam** (M T Khoa PhD); **Section of Medical Oncology, University of the Philippines—College of Medicine, Philippine General Hospital, Manila, Philippines** (C A Ngelangel PhD); **Haematology Department, Yangon General Hospital, Yangon, Myanmar** (H L Nyein MD); **National Cancer Institute of Thailand, Bangkok, Thailand** (S Sangrajrang PhD); **Chonburi Cancer Hospital, Chonburi, Thailand** (J Tanabodee MD)

Introduction

Patients with cancer are increasingly seeking out complementary therapies following cancer diagnoses for many reasons, including amelioration of cancer-therapy-induced side-effects, improvement of general wellbeing, and as the next step after unsuccessful treatment with conventional therapies.[1] Given its rising popularity in oncology settings and in light of compromised patient safety from falsified or substandard complementary medicines obtained from unregulated sources, there is an increasing call to identify and regulate provision of complementary therapies with demonstrated safety and benefits as adjuncts to conventional cancer care.[2,3] There have also been advocacy efforts supporting health insurance reimbursements of complementary medicine for which there is proven benefit for patients with cancer.[4]

Integrative oncology refers to the use of evidence-informed practices, products, or lifestyle modifications alongside conventional cancer treatments.[5] Proponents of integrative oncology often use several arguments to support the integration of complementary medicine into mainstream cancer care, including patients' preference for so-called natural therapies, its purported

Correspondence to:
Dr Nirmala Bhoo-Pathy, Department of Social and Preventive Medicine, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia
nirmala.bhoopathy@ummc.edu.my

Research in context

Evidence before this study

The practice of using complementary medicine is widely embedded within local communities in low-income and middle-income countries. Likewise, complementary medicine is also increasingly sought after by people with cancer. The popularity of complementary medicine use following cancer underscores the growing need for studies examining its financial implications, particularly among economically disadvantaged households in the low-income and middle-income settings. Nonetheless, high-quality evidence on out-of-pocket costs of complementary medicine and the economic impact on households affected by cancer remains scarce. We searched PubMed and Embase between Jan 1, 2000, and March 11, 2021, using the terms "cancer", "complementary medicine", "costs", and "economic impact". Studies in languages other than English were excluded.

Added value of this study

From over 4700 newly diagnosed patients with cancer across eight countries in southeast Asia, data on out-of-pocket health-care spending over 12 months were collected. We found that out-of-pocket costs on complementary medicine might account for a substantial proportion of the overall health expenditures among patients with cancer living in low-income and middle-income countries. Importantly, this study provides empirical evidence suggesting that out-of-pocket spending on complementary medicine might be associated with significantly increased risks of catastrophic expenditures as well as medical impoverishment in the immediate year following cancer diagnoses, with patients from economically disadvantaged households bearing the greatest risk.

Implications of all the available evidence

Our findings highlight the substantial risk of financial ruin to patients and their families from expenditures on complementary therapies for cancer. These data also support subsidisation of evidence-based complementary medicine as part of an integrated model of cancer care for countries moving towards universal health coverage.

health benefits (eg, improving quality of life), and relatively low cost compared with conventional cancer therapies in some settings.[6] Central to this discussion is that, apart from data on efficacy and safety, health-policy makers are increasingly in need of data on costs of complementary medicine to enable formulation of health-care strategies. However, corroborating evidence from the patient's perspective remains insufficient.[6]

Amid the rapid increase in use of complementary medicine by patients with cancer, there is also growing concern that its use might be associated with delays in seeking conventional medical care, with some patients using complementary medicine as an alternative, leading to non-adherence to recommended anticancer therapies, and therefore reduced survival.[7] Complementary medicine might also be an expensive alternative to conventional cancer therapies, leading to serious economic hardship, particularly in resource-limited settings where the practice of using complementary medicine is deeply embedded in some local cultures.[8] This notion is somewhat supported by our findings that the cost of complementary medicine is an important driver of catastrophic expenditures following cancer in Malaysia, a middle-income Asian country.[9] However, given the small sample size of our previous study, we were unable to perform detailed analysis that might offer more insights to facilitate health-policy making including considerations for coverage of complementary medicines in social or national insurance programmes.

To this end, we aimed to investigate the spending patterns on complementary medicine and the association with adverse financial outcomes in the immediate year following cancer diagnoses among participants of the ASEAN Costs in Oncology (ACTION) cohort study, from eight middle-income southeast Asian countries.[10]

Methods

Study design and participants

We derived data from the ACTION study, a prospective longitudinal study that enrolled patients who were newly diagnosed with cancer in 47 centres located in eight countries in southeast Asia: six lower-middle-income countries comprising Cambodia, Myanmar, Laos, Vietnam, Indonesia, and the Philippines; and two upper-middle-income countries comprising Malaysia and Thailand.[10] Patients diagnosed with first time cancer, aged 18 years and older, aware of their cancer diagnosis, and willing to participate in follow-up interviews were eligible. Those in clinical trials were excluded. Detailed methodology of the ACTION study has been published elsewhere.[11]

Procedures

Participants were assessed at baseline (during recruitment) and followed up at 3 months and 12 months. At recruitment, data on age, sex, marital status, highest attained education, private health insurance status (employer-sponsored and individual-sponsored insurance), baseline annual household income, employment status, and experiences of economic hardship in the previous year were collected by trained interviewers. In deriving the household income categories, the individual country's mean national income was used. Annual household income of less than 75% of mean national income was

coded as low, incomes of 75–149% of national mean were coded as middle, and earnings of 150% or more of mean national income were coded as high. The rates of conversion of different currencies are as delineated in the appendix (p 1).

Health-related quality of life at baseline was assessed using the European Organization for Research and Treatment of Cancer quality of life questionnaire core 30 (EORTC QLQ C30),[12] and psychological distress was measured via the Hospital Anxiety and Depression Scale (HADS).[13] Official translations of these questionnaires were available for all countries except Laos and Cambodia for EORTC QLQ C30; translations for HADS were available only for Indonesia, Malaysia, the Philippines, and Thailand. For other countries, the tools were locally translated by professionals using forward-translations and back-translations. Clinical data, including cancer site, cancer stage, cancer therapy administration, and presence of comorbid conditions, were retrieved from the medical records.

All participants were given cost diaries at baseline to record illness-related payments that were directly incurred and not reimbursed by insurance over the 12-month period after study recruitment. Data on out-of-pocket expenditures that were collected included costs associated with conventional cancer care (inpatient and outpatient care, cancer therapy, and medical aid and supplies), non-health costs related to cancer (eg, transportation, childcare, lodging, and domestic help), and complementary medicine use. In recording the expenditures related to complementary medicine in the cost diary, ACTION study participants were explicitly asked to declare the out-of-pocket spending on any traditional or complementary health products or services. Here, complementary medicine was defined as a group of diverse medical and health-care systems, practices, and products that were not considered to be part of conventional medicine, including dietary supplements (eg, vitamins and herbs), traditional medicine (eg, acupuncture and services from traditional healers), mind–body practices (eg, yoga and Qigong), etc.[14]

Annual household income and experience of economic hardship in the 12 months following cancer diagnosis were followed up at the 12-month interview.

Outcomes

The absolute amount of out-of-pocket spending on complementary medicine for each patient was assessed. Spending patterns were subsequently derived as the share of out-of-pocket expenditures on complementary medicine from (1) overall out-of-pocket costs, (2) health costs alone (out-of-pockets costs of conventional cancer care plus cost of complementary medicine), and (3) annual household income, in the 12 months following cancer diagnosis.

The adverse financial outcomes that were assessed comprised (1) financial catastrophe, defined as total out-of-pocket cancer-related costs equivalent to or exceeding 30% of the patient's annual household income;[15] (2) medical impoverishment, defined as out-of-pocket cancer-related costs subtracted from

See Online for appendix

	Out-of-pocket spending on complementary medicine		Multivariable odds ratio (95% CI)*	p value
	Yes (n=1233)	No (n=3521)		
Country income group				
Lower middle	612 (49·6%)	2173 (61·7%)	..	<0·0001
Upper middle	621 (50·4%)	1348 (38·3%)	..	..
Country				
Cambodia	5 (0·4%)	86 (2·4%)	0·24 (0·09–0·65)	0·0016
Indonesia	131 (10·6%)	414 (11·8%)	1·52 (1·14–2·03)	..
Laos	11 (0·9%)	45 (1·3%)	5·06 (2·09–12·22)	..
Malaysia	392 (31·8%)	857 (24·3%)	1·96 (1·54–2·49)	..
Myanmar	173 (14·0%)	374 (10·6%)	2·60 (1·88–3·61)	..
Philippines	69 (5·6%)	376 (10·7%)	0·89 (0·64–1·24)	..
Thailand	229 (18·6%)	491 (13·9%)	2·10 (1·59–2·77)	..
Vietnam	223 (18·1%)	878 (24·9%)	Ref	..
Age, years				
<40	241 (19·5%)	617 (17·5%)	Ref	0·089
40–60	678 (55·0%)	2016 (57·3%)	0·89 (0·74–1·06)	..
>60	314 (25·5%)	888 (25·2%)	0·87 (0·70–1·08)	..
Sex				
Male	420 (34·1%)	1049 (29·8%)	Ref	0·0053
Female	813 (65·9%)	2472 (70·2%)	1·02 (0·84–1·23)	..
Private health insurance†				
Yes	482 (39·1%)	1492 (42·4%)	1·20 (1·02–1·42)	0·043
No	751 (60·9%)	2027 (56·7%)	Ref	..
Employed at baseline				
Yes	644 (52·2%)	1630 (46·3%)	1·16 (1·00–1·35)	0·0003
No	589 (47·8%)	1891 (53·7%)	Ref	..
Poverty at baseline				
Yes	130 (10·5%)	605 (17·2%)	0·73 (0·55–0·96)	0·0007
No	1103 (89·5%)	2916 (82·8%)	Ref	..
Type of hospital				
Public hospital	1184 (96·9%)	3252 (92·8%)	3·16 (2·02–4·94)	<0·0001
Private hospital	38 (3·1%)	252 (7·2%)	Ref	..
Cancer stage				
I	118 (9·6%)	419 (11·9%)	..	0·0011
II	388 (31·5%)	1216 (34·5%)	..	..
III	379 (30·7%)	1102 (31·3%)	..	..
IV	234 (19·0%)	522 (14·8%)	..	..
Haematological cancers	113 (9·2%)	262 (7·4%)	..	..
Cancer site				
Female reproductive cancers	209 (17·0%)	552 (15·7%)	Ref	0·0040
Breast cancer	327 (26·6%)	1160 (33·1%)	0·83 (0·66–1·04)	..
Head and neck cancers	180 (14·7%)	357 (10·2%)	1·19 (0·90–1·57)	..
Gastrointestinal cancers	163 (13·3%)	505 (14·4%)	0·83 (0·62–1·09)	..
Haematological malignancies	113 (9·2%)	262 (7·5%)	0·80 (0·57–1·12)	..
Lung cancer	70 (5·7%)	141 (4·0%)	1·16 (0·80–1·68)	..
Others	166 (13·5%)	528 (15·1%)	0·88 (0·67–1·15)	..

(Table 1 continues on next page)

	Out-of-pocket spending on complementary medicine		Multivariable odds ratio (95% CI)*	p value
	Yes (n=1233)	No (n=3521)		
(Continued from previous page)				
Radiotherapy				
Yes	665 (54·1%)	1660 (47·3%)	1·11 (0·96–1·30)	<0·0001
No	565 (45·9%)	1850 (52·7%)	Ref	..
Surgery				
Yes	625 (50·8%)	2065 (58·8%)	0·85 (0·73–1·00)	<0·0001
No	605 (49·2%)	1445 (41·2%)	Ref	..
Global health status				
Low	869 (70·5%)	2308 (65·6%)	1·16 (0·99–1·37)	0·0016
High	363 (29·5%)	1209 (34·4%)	Ref	..
Social functioning				
Low	660 (53·5%)	1779 (50·5%)	1·16 (0·99–1·36)	0·071
High	573 (46·5%)	1741 (49·5%)	Ref	..
Constipation				
Low	868 (70·5%)	2614 (74·3%)	Ref	0·0094
High	364 (29·5%)	906 (25·7%)	1·11 (0·95–1·31)	..
Diarrhoea				
Low	1066 (86·5%)	3096 (87·9%)	Ref	0·18
High	167 (13·5%)	425 (12·1%)	1·15 (0·93–1·43)	..
Nausea or vomiting				
Low	1019 (82·6%)	2965 (84·2%)	Ref	0·20
High	214 (17·4%)	556 (15·8%)	0·93 (0·76–1·14)	..
Pain				
Low	602 (48·8%)	1820 (51·7%)	Ref	0·083
High	631 (51·2%)	1701 (48·3%)	1·07 (0·91–1·26)	..
Dyspnoea				
Low	873 (70·8%)	2554 (72·5%)	Ref	0·24
High	360 (29·2%)	967 (27·5%)	1·01 (0·85–1·19)	..
Insomnia				
Low	605 (49·1%)	1626 (46·2%)	Ref	0·081
High	627 (50·9%)	1892 (53·8%)	0·86 (0·74–1·00)	..
Anxiety				
No	674 (54·8%)	2000 (57·0%)	Ref	0·17
Yes	557 (45·2%)	1507 (43·0%)	1·12 (0·92–1·37)	..
Depression				
No	671 (54·6%)	2021 (57·7%)	Ref	0·058
Yes	559 (45·4%)	1484 (42·3%)	1·10 (0·92–1·32)	..

Data are n (%), unless otherwise indicated. *Only variables with p values of less than 0·25 in the χ^2 analysis are shown in the table and were included in the multivariable analysis (n=4757). Baseline household income, baseline economic hardship, marital status, education level, presence of comorbidities, chemotherapy administration, hormone therapy administration, baseline physical functioning, baseline role functioning, baseline emotional functioning, baseline cognitive functioning, baseline burden of fatigue, baseline burden of appetite loss, and baseline burden of financial problems were excluded (p values for χ^2 analysis ≥0·25). Country income level (p<0·0001) and cancer stage at diagnosis (p=0·0011) were not included because of collinearity with country and cancer site. †Self-sponsored and employer-sponsored health insurance.

Table 1: **Factors associated with out-of-pocket spending on complementary medicine in the immediate year following cancer diagnosis**

baseline annual household income resulting in a figure below the annual poverty income line; and (3) economic hardship, defined as the self-reported inability to make necessary household payments including mortgages, rent, food, utility bills, child's education fees, etc, at 12 months following cancer diagnosis. The poverty threshold was set at US$1·25 per day.[16] All financial outcomes are not mutually exclusive.

Statistical analysis

The proportion of missingness for each variable is shown in the appendix (p 2). Multiple imputation was done for baseline household income, baseline poverty, poverty at 12 months, cancer stage (excluding haematological malignancies), and financial catastrophe at 12 months. Variables included in the imputation model were country, age, sex, marital status, education level, hospital type, number of people in households, number of people younger than 15 years in household, number of people older than 65 years in household, physical functioning, role functioning, emotional functioning, cognitive functioning, social functioning, global health status, fatigue, nausea and vomiting, pain, dyspnoea, insomnia, appetite loss, constipation, diarrhoea, financial difficulties, anxiety, depression, comorbidity, cancer site, receipt of surgery, receipt of radiotherapy, receipt of chemotherapy, receipt of hormone therapy, baseline economic hardship, economic hardship at 12 months, baseline employment, total out-of-pocket expenditures, and out-of-pocket expenditures on complementary medicine. Ten imputation models were used.

Categorical variables were presented as percentages and compared using χ^2 test. Continuous variables were described as median (IQR) and compared using non-parametric tests because most variables were not normally distributed; Mann-Whitney U test was used for two subgroups, and Kruskal-Wallis for more than two subgroups. Baseline characteristics of households who reported making out-of-pocket payments for complementary expenditures were compared with those who did not via χ^2 tests. Variables with a p value of less than 0·25 in the univariable analyses were included in the multivariable logistic regression analysis to assess the association between patient characteristics and spending on complementary medicine. Multivariable logistic regression analyses were also done to investigate the association between out-of-pocket spending on complementary medicine with incidence of financial catastrophe, medical impoverishment, and economic hardship at 1 year after cancer diagnosis, which were adjusted for variables that were associated with both spending on complementary medicine and the adverse financial outcomes. Subgroup analyses on economically disadvantaged households (low-income status, previous economic hardship, unemployed, or no private health insurance) as well as by country income group, country, and cancer site were done. Odds ratios (ORs) were considered statistically significant when the 95% CIs did not include 1, and p values below 0·05 were considered statistically significant. All analyses were done using SPSS (version 22).

Role of the funding source
There was no funding source for this study.

Results

Between March, 2012, and September, 2013, 9513 participants were recruited into the ACTION cohort study. 1993 (21·0%) died, 1614 (17·0%) were lost to follow up, and 660 (6·9%) withdrew. A further 492 (5·2%) did not provide adequate details in the cost diaries on categories of their out-of-pocket spending, leaving 4754 (50·0%) participants in the present analysis.

Of the 4754 participants, 2785 (58·6%) resided in lower-middle-income countries, and 1969 (41·4%) were from upper-middle-income countries. The most common cancers were breast cancer (31·4%), female reproductive cancer (16·1%), and gastrointestinal cancer (14·1%; appendix p 3). Most participants were aged 40–60 years at time of cancer diagnoses and most participants had attained at least secondary level education. Over half were unemployed and approximately 40% of the study participants had private health insurance. 1720 (36·2%) participants lived in low-income households, 1204 (25·3%) were from middle-income households, and 1830 (38·5%) were from high-income households. 2371 (49·9%) participants reported economic hardship in the year preceding cancer diagnosis, and 736 (15·5%) were impoverished. Many participants presented with late-stage cancers,

	Amount spent on complementary medicine, US$	Overall out-of-pocket payments, US$	Total out-of-pocket health costs, US$	Share of complementary medicine costs from overall out-of-pocket costs	Share of complementary medicine costs from health costs	Share of complementary medicine costs from annual household income
Country income group						
Lower middle	$117 (48–320)	$2725 (1297–4967)	$1779 (852–3421)	4·8% (1·9–15·7)*	8·6% (2·6–26·9)*	5·3% (1·6–19·4)
Upper middle	$392 (136–982)	$2193 (982–4943)	$982 (323–2619)	16·1% (7·7–30·6)*	42·9% (20·0–78·9)*	6·3% (2·2–13·0)
Country						
Indonesia	$166 (47–467)	$2336 (748–4361)	$626 (187–1786)	12·3% (2·5–31·9)*	30·4% (11·1–81·0)*	15·8% (2·7–23·6)*
Malaysia	$655 (327–1146)	$3601 (1637–7365)	$1948 (755–3858)	19·1% (10·5–32·1)*	37·7% (19·2–66·6)*	8·0% (3·8–16·2)*
Myanmar	$59 (35–117)	$2727 (1206–4916)	$2443 (1039–4395)	2·6% (1·4–5·8)*	3·3% (1·6–7·4)*	2·2% (1·2–8·3)*
Philippines	$122 (73–365)	$3894 (2641–6133)	$1825 (1229–3149)	3·8% (1·8–8·5)*	8·6% (3·3–21·1)*	7·7% (2·6–23·3)*
Thailand	$118 (39–280)	$1111 (688–1814)	$284 (137–668)	11·1% (3·8–27·2)*	59·0% (24·7–91·9)*	2·6% (1·0–7·4)*
Vietnam	$192 (58–384)	$2634 (1464–4657)	$1992 (1104–3346)	7·4% (2·3–17·2)*	10·7% (3·1–27·0)*	9·0% (3·7–28·3)*
Cancer site						
Female reproductive cancers	$140 (49–327)	$1544 (810–2902)	$732 (279–1954)	10·9% (2·9–30·5)*	27·3% (8·3–70·9)*	4·8% (1·9–13·2)*
Breast cancer	$327 (98–818)	$3453 (1599–6972)	$1827 (700–3675)	9·9% (4·0–26·0)*	21·7% (8·0–60·0)*	7·8% (2·9–16·7)*
Head and neck cancers	$71 (39–310)	$2481 (1076–4565)	$1463 (629–3370)	4·6% (2·2–13·0)*	7·4% (2·7–33·5)*	2·6% (1·2–7·8)*
Gastrointestinal cancers	$327 (119–818)	$3110 (1508–6383)	$1800 (751–3802)	11·1% (4·7–22·2)*	22·8% (9·1–48·3)*	8·7% (2·7–18·2)*
Haematological cancers	$291 (110–556)	$1637 (880–3316)	$664 (401–1661)	22·1% (8·4–37·4)*	54·5% (20·7–70·8)*	4·6% (1·8–11·0)*
Lung cancer	$288 (75–893)	$3764 (2329–6274)	$2663 (1151–5503)	8·9% (2·2–21·6)*	16·7% (3·1–38·4)*	6·9% (3·5–19·4)*
Household income						
Low	$295 (98–655)	$2494 (1164–5611)	$1255 (455–2754)	12·6% (5·4–26·2)*	28·6% (13·0–65·8)*	10·7% (4·3–23·9)*
Middle	$229 (65–624)	$2498 (997–5092)	$1217 (480–3330)	11·3% (3·3–23·7)*	24·8% (6·5–52·0)*	5·8% (2·2–13·0)*
High	$151 (58–491)	$2619 (1206–4648)	$1606 (700–3406)	8·0% (2·3–24·4)*	14·9% (3·9–57·8)*	3·7% (1·4–9·2)*
Previous economic hardship						
No	$225 (62–655)	$2746 (1166–4959)	$1555 (615–3325)	9·0% (3·2· 25·9)	21·1% (5·2–57·1)*	4·9% (1·6–12·8)*
Yes	$212 (66–589)	$2323 (1103–4945)	$1219 (391–2839)	10·9% (3·6–23·8)	25·0% (8·8–64·7)*	7·6% (2·6–19·3)*
Previous poverty						
No	$229 (65–655)	$2641 (1196–5080)	$1438 (534–3242)	10·6% (3·5–25·0)	23·9% (7·0–60·0)	5·6% (2·9–14·1)*
Yes	$122 (40–288)	$1607 (761–3499)	$939 (304–2389)	8·9% (3·0–22·6)	17·2% (6·7–60·0)	11·7% (3·7–36·6)*
Employed at baseline						
No	$260 (83–655)	$2641 (1246–5310)	$1440 (550–3281)	10·8% (4·5–23·6)	22·4% (8·6–57·7)	7·2% (2·6–18·2)*
Yes	$178 (59–539)	$2401 (1054–4648)	$1309 (458–2977)	9·3% (2·8–26·4)	22·8% (5·3–64·2)	4·7% (1·5–13·0)*
Ownership of private health insurance†						
No	$198 (59–655)	$2455 (1086–4975)	$1329 (529–3270)	9·5% (3·6–24·6)	22·6% (6·7–60·0)	5·2% (1·6–13·0)*
Yes	$240 (82–498)	$2626 (1198–4943)	$1437 (462–2935)	11·5% (3·2–25·0)	22·7% (7·7–59·4)	7·3% (2·9–18·8)*

Data are median (IQR). *Statistically significant in Mann-Whitney U test (two subgroups) or Kruskal Wallis test (more than two subgroups). †Self-sponsored and employer-sponsored health insurance.

Table 2: **Share of complementary medicine costs from overall out-of-pocket costs, total health costs, and annual household income in 1233 households reporting expenditures on complementary medicine following cancer diagnoses**

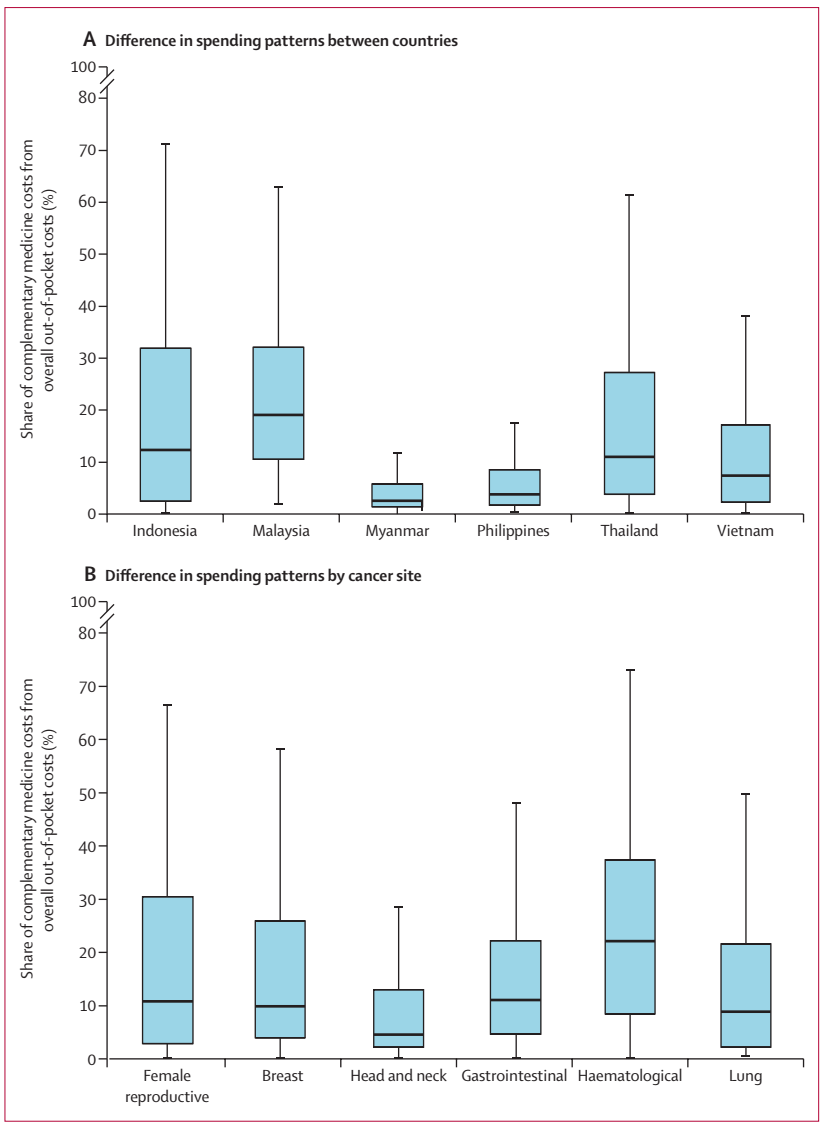

Figure: **Share of complementary medicine costs from overall out-of-pocket costs by country and cancer type**
Line indicates median and whiskers minimum and maximum. Numbers for Laos and Cambodia were too small to create boxplots.

with 2658 (61·4%) receiving some form of cancer surgery. Overall, 3503 (73·9%) received chemotherapy and 2325 (49·1%) received radiotherapy. Comorbidities were reported in 1081 (22·8%) of participants.

1233 participants reported out-of-pocket spending on complementary medicine in the immediate year following cancer diagnosis, comprising 612 (22·0%) participants from households from lower-middle-income countries and 621 (31·5%) from upper-middle-income countries. Multivariable analysis showed that factors that were significantly associated with out-of-pocket spending on complementary medicine were: being from Indonesia, Laos, Malaysia, Myanmar, or Thailand (reference: Vietnam); being managed in public hospitals; and having private health insurance (table 1). By contrast, Cambodian households and those who were impoverished at baseline were independently less likely to report spending on complementary medicine (table 1).

Median out-of-pocket expenditure on complementary medicine over 12 months was US$117 (IQR 48–320) in lower-middle-income countries (n=612), and $392 (136–982) in upper-middle-income countries (n=621; table 2). On average, 5% of the overall out-of-pockets costs, 9% of health costs, and 5% of total annual household income in lower-middle-income countries were spent on complementary medicine (table 2). By contrast, in upper-middle-income countries, expenditures on complementary medicine constituted 16% of overall out-of-pockets costs, 43% of health costs, and 6% of total annual household income (table 2). Among the 384 households with data on costs of the specific types of complementary medicine that were used, expenditure on traditional local medicine was most commonly reported (62%; median cost $430 [169–1002]), followed by food and nutritional supplements (39%; median cost $786 [318–1473]; not mutually exclusive; data not shown).

We found significant differences in spending patterns by cancer sites and between countries (table 2; figure). Participants with haematological malignancies, for instance, reported the highest share of expenditures on complementary medicine compared with those with other cancers (table 2; figure). Compared with their higher-income counterparts, participants from low-income households (15% *vs* 29%) and those who reported economic hardship in the year preceding cancer diagnosis (21% *vs* 25%) were significantly more likely to spend higher shares of their health expenditures on complementary medicine (table 2). Likewise, economically disadvantaged households also spent relatively higher shares of their household income on complementary medicine (table 2).

In upper-middle-income countries, households that reported out-of-pocket spending on complementary medicine were associated with significantly higher risks of financial catastrophe (adjusted OR [aOR] 1·52 [95% CI 1·23–1·88]) and medical impoverishment (1·75 [1·36–2·24]) at 1 year after cancer diagnosis, compared with their counterparts who did not report such expenditures (tables 3, 4). However, spending on complementary medicine was not associated with economic hardship (1·07 [0·78–1·47; table 5). In lower-middle-income countries, associations between out-of-pocket expenditure on complementary medicine and adverse financial outcomes were not significant (tables 3–5).

Country-stratified analysis largely revealed positive associations between out-of-pocket spending on complementary medicine and risk of financial catastrophe (aORs ranging from 1·17 in Indonesia to 1·83 in Vietnam) and medical impoverishment (aORs ranging from 1·63 in Vietnam to 1·80 in Malaysia), although results were not statistically significant in some instances (tables 3, 4). Spending on complementary medicine

	Patients	Financial catastrophe at 1 year*		Adjusted odds ratio (95% CI)†
		Yes (n=3340)	No (n=1414)	
Country income group				
Lower middle				
Out-of-pocket spending	612 (22·0%)	97 (5·0%)	515 (61·0%)	0·89 (0·63–1·25)
No out-of-pocket spending	2173 (78·0%)	1844 (95·0%)	329 (39·0%)	Ref
Upper middle				
Out-of-pocket spending	621 (31·5%)	340 (34·7%)	281 (28·4%)	1·52 (1·23–1·88)
No out-of-pocket spending	1348 (68·5%)	641 (65·3%)	707 (71·6%)	Ref
Country				
Indonesia				
Out-of-pocket spending	131 (24·0%)	94 (24·6%)	37 (22·7%)	1·17 (0·61–2·23)
No out-of-pocket spending	414 (76·0%)	288 (75·4%)	126 (77·3%)	Ref
Malaysia				
Out-of-pocket spending	392 (31·2%)	236 (33·6%)	156 (28·6%)	1·45 (1·09–1·91)
No out-of-pocket spending	857 (68·6%)	467 (66·4%)	390 (71·4%)	Ref
Myanmar				
Out-of-pocket spending	173 (31·6%)	140 (28·6%)	33 (57·9%)	0·43 (0·20–0·90)
No out-of-pocket spending	374 (68·4%)	350 (71·4%)	24 (42·1%)	Ref
Philippines				
Out-of-pocket spending	69 (15·5%)	62 (15·5%)	7 (15·9%)	0·99 (0·36–2·78)
No out-of-pocket spending	376 (84·5%)	339 (84·5%)	37 (84·1%)	Ref
Thailand				
Out-of-pocket spending	229 (31·8%)	104 (37·4%)	125 (28·3%)	1·68 (1·19–2·38)
No out-of-pocket spending	491 (68·2%)	174 (62·6%)	317 (71·7%)	Ref
Vietnam				
Out-of-pocket spending	223 (20·3%)	211 (20·8%)	12 (13·8%)	1·83 (0·86–3·88)
No out-of-pocket spending	878 (79·7%)	803 (79·2%)	75 (86·2%)	Ref
Cancer site				
Female reproductive cancers				
Out-of-pocket spending	209 (27·5%)	145 (28·5%)	64 (25·3%)	1·49 (0·95–2·34)
No out-of-pocket spending	552 (72·5%)	363 (71·5%)	189 (74·7%)	Ref
Breast cancer				
Out-of-pocket spending	327 (22·0%)	234 (21·1%)	93 (24·7%)	1·33 (0·90–1·96)
No out-of-pocket spending	1160 (78·0%)	876 (78·9%)	284 (75·3%)	Ref

(Table 3 continues in next column)

	Patients	Financial catastrophe at 1 year*		Adjusted odds ratio (95% CI)†
		Yes (n=3340)	No (n=1414)	
(Continued from previous column)				
Head and neck cancers				
Out-of-pocket spending	180 (33·5%)	127 (33·4%)	53 (33·8%)	1·50 (0·90–2·49)
No out-of-pocket spending	357 (66·5%)	253 (66·6%)	104 (66·2%)	Ref
Gastrointestinal cancers				
Out-of-pocket spending	163 (24·4%)	123 (24·1%)	40 (25·3%)	1·34 (0·83–2·19)
No out-of-pocket spending	505 (75·6%)	387 (75·9%)	118 (74·7%)	Ref
Haematological malignancies				
Out-of-pocket spending	113 (30·1%)	59 (37·6%)	54 (24·8%)	3·16 (1·66–6·00)
No out-of-pocket spending	262 (69·9%)	98 (62·4%)	164 (75·2%)	Ref
Lung cancer				
Out-of-pocket spending	70 (33·2%)	55 (35·0%)	15 (27·8%)	1·96 (0·76–5·05)
No out-of-pocket spending	141 (66·8%)	102 (65·0%)	39 (72·2%)	Ref
Subgroup				
Low income				
Out-of-pocket spending	431 (25·1%)	346 (26·3%)	85 (21·1%)	1·80 (1·29–2·50)
No out-of-pocket spending	1289 (74·9%)	972 (73·7%)	317 (78·9%)	Ref
Previous economic hardship				
Out-of-pocket spending	608 (25·6%)	447 (25·8%)	161 (25·3%)	1·38 (1·05–1·80)
No out-of-pocket spending	1763 (74·4%)	1288 (74·2%)	475 (74·7%)	Ref
Unemployed				
Out-of-pocket spending	589 (23·8%)	438 (24·1%)	151 (22·9%)	1·35 (1·04–1·77)
No out-of-pocket spending	1891 (76·3%)	1382 (75·9%)	509 (77·1%)	Ref
No private health insurance‡				
Out-of-pocket spending	751 (27·0%)	241 (25·9%)	510 (27·6%)	1·43 (1·15–1·78)
No out-of-pocket spending	2027 (73·0%)	690 (74·1%)	1337 (72·4%)	Ref

Data are n (%), unless otherwise indicated. *Financial catastrophe was defined as out-of-pocket expenditures related to cancer equivalent to or exceeding 30% of annual household income. †Odds ratio was derived using multivariable logistic regression analysis adjusted for variables that were associated with spending on complementary medicine and incidence of financial catastrophe with p values of less than 0·25, comprising country, age at diagnosis, sex, ownership of private health insurance, employed at baseline, poverty at baseline, type of hospital, cancer stage at diagnosis, radiotherapy administration, receipt of surgery, global health status at baseline, social functioning at baseline, baseline burden of pain, baseline burden of diarrhea, baseline burden of insomnia, baseline anxiety status, and baseline depression status. Models used in subgroup analyses excluded the respective variables in which the subgroup was derived. Models used for cancer site excluded cancer stage at diagnosis. ‡Self-sponsored and employer-sponsored health insurance.

Table 3: **Association between out-of-pocket spending on complementary medicine following cancer and risk of financial catastrophe**

	Patients	Medical impoverishment at 1 year*		Adjusted odds ratio (95% CI)†
		Yes (n=1517)	No (n=1850)	
Country income group				
Lower middle				
Out-of-pocket spending	509 (23·5%)	53 (16·3%)	456 (24·8%)	0·95 (0·73–1·24)
No out-of-pocket spending	1657 (76·5%)	273 (83·7%)	1384 (75·2%)	Ref
Upper middle				
Out-of-pocket spending	593 (32·0%)	16 (29·1%)	577 (32·1%)	1·75 (1·36–2·24)
No out-of-pocket spending	1258 (68·0%)	39 (70·9%)	1220 (67·9%)	Ref
Country				
Indonesia				
Out-of-pocket spending	17 (27·4%)	8 (25·8%)	9 (29·0%)	..
No out-of-pocket spending	45 (72·6%)	23 (74·2%)	22 (71·0%)	Ref
Malaysia				
Out-of-pocket spending	362 (31·6%)	118 (38·7%)	244 (29·1%)	1·80 (1·34–2·42)
No out-of-pocket spending	782 (68·4%)	187 (61·3%)	595 (70·9%)	Ref
Myanmar				
Out-of-pocket spending	160 (32·9%)	93 (27·9%)	67 (43·5%)	0·76 (0·47–1·22)
No out-of-pocket spending	327 (67·1%)	240 (72·1%)	87 (56·5%)	Ref
Philippines				
Out-of-pocket spending	49 (16·3%)	32 (15·5%)	17 (18·1%)	0·93 (0·44–2·00)
No out-of-pocket spending	251 (83·7%)	174 (84·5%)	77 (81·9%)	Ref
Thailand				
Out-of-pocket spending	204 (34·2%)	40 (44·0%)	164 (32·5%)	1·71 (1·06–2·75)
No out-of-pocket spending	392 (65·8%)	51 (56·0%)	341 (67·5%)	Ref
Vietnam				
Out-of-pocket spending	166 (21·5%)	127 (23·3%)	39 (17·1%)	1·63 (1·05–2·52)
No out-of-pocket spending	606 (78·5%)	417 (76·7%)	189 (82·9%)	Ref

(Table 4 continues in next column)

(Continued from previous column)

	Patients	Medical impoverishment at 1 year*		Adjusted odds ratio (95% CI)†
		Yes (n=1517)	No (n=1850)	
Cancer site				
Female reproductive cancers				
Out-of-pocket spending	150 (29·1%)	85 (29·5%)	65 (28·6%)	1·27 (0·75–2·14)
No out-of-pocket spending	365 (70·9%)	203 (70·5%)	162 (71·4%)	Ref
Breast cancer				
Out-of-pocket spending	251 (25·5%)	118 (23·2%)	132 (27·8%)	1·30 (0·89–1·90)
No out-of-pocket spending	734 (74·5%)	391 (76·8%)	343 (72·2%)	Ref
Head and neck cancers				
Out-of-pocket spending	150 (38·5%)	63 (32·5%)	87 (44·4%)	1·46 (0·83–2·58)
No out-of-pocket spending	240 (61·5%)	131 (67·5%)	109 (55·6%)	Ref
Gastrointestinal cancers				
Out-of-pocket spending	138 (25·8%)	65 (25·8%)	73 (25·9%)	1·49 (0·93–2·41)
No out-of-pocket spending	396 (74·2%)	187 (74·2%)	209 (74·1%)	Ref
Haematological malignancies				
Out-of-pocket spending	88 (30·1%)	69 (63·9%)	19 (10·3%)	3·26 (1·31–8·12)
No out-of-pocket spending	204 (69·9%)	39 (36·1%)	165 (89·7%)	Ref
Lung cancer				
Out-of-pocket spending	57 (33·1%)	32 (35·6%)	25 (30·5%)	1·68 (0·68–4·14)
No out-of-pocket spending	115 (66·9%)	58 (64·4%)	57 (69·5%)	Ref

(Table 4 continues in next column)

nonetheless was not associated with financial hardship or medical impoverishment in the Philippines. However, we found significant associations with economic hardship in the Philippines and Vietnam (table 5). In Myanmar, expenditure on complementary medicine, versus no such spending, was consistently associated with lower risk of adverse financial outcomes (tables 3, 4, 5).

Patients with haematological malignancies reporting out-of-pocket expenditures on complementary medicine were also found to have substantially increased risk of adverse financial outcomes (aOR for financial catastrophe 3·16 [95% CI 1·66–6·00]; aOR for medical impoverishment 3·26 [1·31–8·12]; aOR for economic hardship 2·33 [1·03–5·77; tables 3–5).

Independent of country of origin, out-of-pocket spending on complementary medicine was consistently associated with increased risks of financial catastrophe and medical impoverishment among economically vulnerable households—eg, in the low-income groups and those reporting previous economic hardship (tables 3, 4).

The main results were materially unchanged following sensitivity analyses using higher thresholds to define financial catastrophe (for lower-middle-income countries aOR 0·68 [95% CI 0·49–0·93] for 40% threshold and 0·67 [0·50–0·89] for 50% threshold, and for upper-middle-income countries 1·60 [1·28–1·99] for 40% threshold and 1·62 [1·30–2·03] for 50% threshold).

	Patients	Medical impoverishment at 1 year*		Adjusted odds ratio (95% CI)†
		Yes (n=1517)	No (n=1850)	
(Continued from previous column)				
Subgroup				
Low income				
Out-of-pocket spending	270 (28·9%)	665 (81·9%)	123 (25·0%)	2·21 (1·59–3·07)
No out-of-pocket spending	665 (71·1%)	147 (18·1%)	369 (75·0%)	Ref
Previous economic hardship				
Out-of-pocket spending	434 (27·6%)	205 (27·3%)	229 (27·9%)	1·45 (1·11–1·90)
No out-of-pocket spending	1138 (72·4%)	546 (72·7%)	592 (72·1%)	Ref
Unemployed				
Out-of-pocket spending	432 (26·6%)	209 (26·9%)	223 (26·3%)	1·31 (1·01–1·69)
No out-of-pocket spending	1195 (73·4%)	569 (73·1%)	626 (73·7%)	Ref
No private health insurance‡				
Out-of-pocket spending	622 (30·0%)	256 (29·9%)	366 (30·1%)	1·33 (1·06–1·67)
No out-of-pocket spending	1451 (70·0%)	600 (70·1%)	851 (69·9%)	Ref

Data are n (%), unless otherwise indicated. *Medical impoverishment was defined as a case when a household with income above the poverty line at baseline incurred out-of-pocket costs over 12 months, which, when subtracted from household income at 12 months, brought that household below the poverty line. †Analysis excluded patients who were in poverty at baseline. Odds ratio was derived using multivariable logistic regression analysis adjusted for variables that were associated with spending on complementary medicine, and incidence of medical impoverishment with p values of less than 0·25, comprising country, age at diagnosis, sex, ownership of private health insurance, employed at baseline, type of hospital, radiotherapy administration, receipt of surgery, global health status at baseline, social functioning at baseline, baseline burden of constipation, baseline burden of diarrhoea, baseline burden of nausea or vomiting, baseline burden of pain, baseline burden of dyspnoea, baseline burden of insomnia, baseline anxiety status, and baseline depression status. Models used in subgroup analyses excluded the respective variables in which the subgroup was derived. ‡Self-sponsored and employer-sponsored health insurance.

Table 4: **Association between out-of-pocket spending on complementary medicine following cancer and risk of medical impoverishment**

Discussion

Spending patterns on complementary medicine and the associated adverse financial outcomes differed significantly by country-level income and by household economic status. Notably, out-of-pocket expenditures on complementary medicine were significantly associated with increased risks of financial catastrophe and medical impoverishment in the immediate year after cancer diagnosis in upper-middle-income countries. A strikingly common observation nonetheless was that the economically disadvantaged households who reported out-of-pocket spending on complementary medicine were more susceptible to adverse financial outcomes, irrespective of country of origin.

In this study, out-of-pocket expenditures on complementary medicine, on average, accounted for almost 10% of the overall health costs that were incurred in the immediate year after cancer diagnoses among households from lower-middle-income countries, compared with that of about 45% among their counterparts from upper-middle-income countries. This finding to some extent might be explained by the fact that cancer care is highly subsidised in the public health-care sector in Malaysia and Thailand, which are both upper-middle-income countries in southeast Asia with universal health coverage. Thus, in these settings, reduced out-of-pocket expenditures for conventional cancer care might have allowed patients to spend on complementary medicine. Given the wide acceptance of complementary medicine use following cancer at the global level, similar spending patterns could exist in other higher-income countries with universal health coverage, although evidence is scarce. However, country-specific analysis in Indonesia, a lower-middle-income economy, also revealed that approximately a third of the health costs incurred by the cancer-affected households was on complementary medicine. This finding suggests that, apart from health-system-related factors, strong sociocultural beliefs about complementary medicine in the southeast Asian setting might have also contributed to its continued use by people with cancer, particularly when the prognosis was viewed as unfavourable.[17] Furthermore, in settings with poor access to conventional cancer care such as in the Philippines and Myanmar, complementary therapies might have been used as the primary treatment option for cancer as cheaper alternatives to conventional treatment, which tends to be perceived as prohibitively expensive.

This notion is further corroborated by the findings that economically disadvantaged households spent significantly higher shares of their health expenditures and household income on complementary medicine, compared with their counterparts who were financially better off, irrespective of their country of origin. These households might have perceived complementary medicine as being more readily available and accessible,[18] owing to challenges in accessing conventional cancer care. Complementary medicine might have been viewed as a cheaper option, as the costs are usually one-off, with fewer upfront payments.[18] Besides the high costs of conventional cancer therapies, economically vulnerable households could have had additional access barriers due to psychosocial factors, issues in navigating cancer care, and paternalistic doctor–patient relationships.[19]

Our findings show increased risks of financial catastrophe and impoverishment due to spending on complementary medicine following cancer. This finding challenges the public perception that complementary medicine's use is unlikely to be associated with substantial financial burden.[20] Because complementary medicine is often used as adjunct to conventional cancer

	Patients	Economic hardship at 1 year*		Adjusted odds ratio (95% CI)†
		Yes (n=1102)	No (n=1268)	
Country income group				
Lower middle				
Out-of-pocket spending	307 (23·6%)	164 (26·7%)	143 (20·8%)	1·24 (0·94–1·64)
No out-of-pocket spending	996 (76·4%)	451 (73·3%)	545 (79·2%)	Ref
Upper middle				
Out-of-pocket spending	315 (29·5%)	141 (29·0%)	174 (30·0%)	1·07 (0·78–1·47)
No out-of-pocket spending	752 (70·5%)	346 (71·0%)	406 (70·0%)	Ref
Country				
Indonesia				
Out-of-pocket spending	52 (21·9%)	34 (22·8%)	18 (20·5%)	1·50 (0·74–3·06)
No out-of-pocket spending	185 (78·1%)	115 (77·2%)	70 (79·5%)	Ref
Malaysia				
Out-of-pocket spending	224 (29·2%)	119 (28·7%)	105 (29·7%)	1·15 (0·78–1·68)
No out-of-pocket spending	543 (70·8%)	295 (71·3%)	248 (70·3%)	Ref
Myanmar				
Out-of-pocket spending	140 (35·0%)	60 (32·1%)	80 (37·6%)	0·74 (0·43–1·25)
No out-of-pocket spending	260 (65·0%)	127 (67·9%)	133 (62·4%)	Ref
Philippines				
Out-of-pocket spending	16 (15·1%)	13 (27·1%)	3 (5·2%)	6·62 (1·17–37·44)
No out-of-pocket spending	90 (84·9%)	35 (72·9%)	55 (94·8%)	Ref
Thailand				
Out-of-pocket spending	91 (30·3%)	22 (30·1%)	69 (30·4%)	0·91 (0·49–1·69)
No out-of-pocket spending	209 (69·7%)	51 (69·9%)	158 (69·6%)	Ref
Vietnam				
Out-of-pocket spending	92 (17·6%)	52 (23·3%)	40 (13·3%)	1·75 (1·07–2·85)
No out-of-pocket spending	432 (82·4%)	171 (76·7%)	261 (86·7%)	Ref
Cancer site				
Female reproductive cancers				
Out-of-pocket spending	85 (26·0%)	45 (32·4%)	40 (21·3%)	1·69 (0·93–3·08)
No out-of-pocket spending	242 (74·0%)	94 (67·6%)	148 (78·7%)	Ref
Breast cancer				
Out-of-pocket spending	154 (19·8%)	86 (22·2%)	68 (17·4%)	1·27 (0·85–1·90)
No out-of-pocket spending	623 (80·2%)	301 (77·8%)	322 (82·6%)	Ref
Head and neck cancers				
Out-of-pocket spending	112 (37·6%)	38 (29·0%)	74 (44·3%)	1·02 (0·52–1·97)
No out-of-pocket spending	186 (62·4%)	93 (71·0%)	93 (55·7%)	Ref
Gastrointestinal cancers				
Out-of-pocket spending	81 (27·2%)	51 (30·2%)	30 (23·3%)	1·68 (0·89–3·20)
No out-of-pocket spending	217 (72·8%)	118 (69·8%)	99 (76·7%)	Ref
Haematological malignancies				
Out-of-pocket spending	69 (29·7%)	16 (34·0%)	53 (28·6%)	2·33 (1·03–5·27)
No out-of-pocket spending	163 (7·03%)	31 (66·0%)	132 (71·4%)	Ref
Lung cancer				
Out-of-pocket spending	41 (36·3%)	29 (39·7%)	12 (30·0%)	2·48 (0·75–8·20)
No out-of-pocket spending	72 (63·7%)	44 (60·3%)	28 (70·0%)	Ref
Subgroup				
Low income				
Out-of-pocket spending	167 (25·9%)	104 (29·1%)	63 (22·0%)	1·44 (0·91–2·27)
No out-of-pocket spending	478 (74·1%)	254 (70·9%)	224 (78·0%)	Ref
Unemployed				
Out-of-pocket spending	289 (24·6%)	149 (26·8%)	140 (22·6%)	1·16 (0·85–1·58)
No out-of-pocket spending	887 (75·4%)	407 (73·2%)	480 (77·4%)	Ref
No private health insurance‡				
Out-of-pocket spending	406 (28·3%)	195 (28·8%)	211 (27·8%)	1·11 (0·85–1·44)
No out-of-pocket spending	1030 (71·7%)	481 (71·2%)	549 (72·2%)	Ref

Data are n (%), unless otherwise indicated. *Economic hardship was defined as the self-reported inability to make necessary household payments including mortgages, rent, food, utility bills, child's education fees, etc, following cancer diagnosis. †Analysis excluded patients who reported economic hardship at baseline. Odds ratio was derived using multivariable logistic regression analysis adjusted for variables that were associated with spending on complementary medicine, and incidence of economic hardship with p values of less than 0·25, comprising country, sex, cancer stage at diagnosis, radiotherapy administration, receipt of surgery, global health status at baseline, social functioning at baseline, baseline burden of nausea and vomiting, baseline burden of pain, baseline burden of insomnia, baseline anxiety status, and baseline depression status. Models used in subgroup analyses excluded the respective variables in which the subgroup was derived. Models used for cancer site excluded cancer stage at diagnosis. ‡Self-sponsored and employer-sponsored health insurance.

Table 5: **Association between out-of-pocket spending on complementary medicine following cancer and risk of economic hardship**

therapies, additional costs are to be expected.[6,21] Concurrent expenditures on both conventional cancer therapy and complementary medicine during the active treatment phase were shown to be financially catastrophic, especially for lower-income households. Although we acknowledge limitations in the data on costs of specific types of complementary medicine in this study, almost 40% of households had reported out-of-pocket expenditures on nutritional supplements. This finding is corroborated by previous studies, which have shown that use of unproven complementary therapies, especially nutritional supplements, were high among patients with cancer,[22,23] as was also reported in the region.[24,25] Patients, therefore, must be made aware of not only the ineffectiveness of certain complementary medicine but also the ensuing financial harm that these products can bring.[26]

Amid the increasing evidence supporting the role of several complementary therapies such as acupuncture and traditional herbal medicine in alleviating cancer symptoms and side-effects of conventional cancer therapy,[27,28] our study provides evidence to support the integration of such therapies into mainstream cancer care and insurance benefit packages to reduce the financial impact on households affected by cancer. In settings where complementary medicine is widely used, establishment of integrated oncology centres might not only improve adherence to conventional treatments, but also prevent unwanted side-effects from interactions between conventional therapy and complementary medicine due to non-disclosure by patients.[29] Besides enabling regulation of the costs of the complementary therapies, such an integration also has important implications towards the payment mechanism for complementary medicine, including reducing out-of-pocket payments via reimbursement systems from third-party payers or government funding, depending on the health-financing system in place.[30] Specifically, integrated oncology services can reduce out-of-pocket health costs by offering financial protection to economically disadvantaged households that are more likely to use complementary medicine yet also face an increased risk of adverse financial outcomes, as shown in the present study.

To the best of our knowledge, this is the only multicountry cohort study that prospectively captured expenditures on complementary medicine in the immediate year after cancer diagnosis through patient diaries, thereby minimising recall bias. Although our study focused on patients living in middle-income countries, our findings remain relevant to economically vulnerable households outside the region, including patients with cancer living in high-income countries who are uninsured, from lower socioeconomic backgrounds, or from minority groups. However, we were limited in performing detailed analysis on out-of-pocket costs by specific types of complementary medicine by a lack of finer details in the cost diaries. Shares of total out-of-pocket spending were mainly reported because presentation of absolute costs might lead to complexities in interpretation of findings because of variation in currencies and other country-specific characteristics. Additionally, some households might have chosen to not disclose their expenditures on complementary medicine because of fear of disapproval by the oncology professionals. Nonetheless, this non-disclosure indicates that our study findings might be conservative.

In this study, cancer-stricken households residing in upper-middle-income economies with universal health coverage spent significantly higher shares of their out-of-pocket and health costs on complementary medicine, compared with their counterparts from lower-middle-income countries. Such expenditures were significantly associated with increased incidences of financial catastrophe and medical impoverishment. Equally important is the finding that the economically disadvantaged households were disproportionately affected by out-of-pocket spending on complementary medicine following cancer diagnosis, which in turn might put these patients at increased risk of refusing or discontinuing conventional cancer care. Integration of evidence-supported complementary therapies into mainstream cancer care, along with interventions to address use of non-evidence-based treatments, might potentially alleviate any associated adverse financial impacts.

Contributors

Y-CK, SSu, and SJ contributed to formal analysis, writing the original draft, manuscript review, and editing. MK contributed to data curation, formal analysis, writing the original draft, manuscript review, and editing. C-HY contributed to data curation, manuscript writing, review, and editing. SA, MTK, CAN, HLN, SSu, and JT contributed to data curation, manuscript writing, review, and editing. NB-P contributed to conceptualisation, data curation, formal analysis, writing the original draft, manuscript review, and editing.

Declaration of interests

MK's salary at the time of the project (2011–14) was partly funded by an unrestricted education grant from the Roche Asia Pacific Regional Office to her employer at the time (The George Institute for Global Health, Sydney, NSW, Australia). SA received honoraria for events from Roche Myanmar (2019–20), Mylan Pharmaceuticals (2019), ABC International (2019–21), and Eisai (2021); support for attending meetings or travel from ABC International; and participated in ESMO Global Policy (member, 2017–19), ASCO Asia Pacific Regional (council member, 2019 to present), and Myanmar Oncology society (president, 2010 to present). NBP received education grants from Novartis, Pfizer, AIA, and the Pharmaceutical Association of Malaysia; speaker's fees for lectures from Novartis, Pfizer, and Roche; support for attending meetings or travel from Roche and the Pharmaceutical Association of Malaysia; research material support from Roche Diagnostics; and participated in Pfizer Asia Pacific, Malaysia (advisory board, 2017–18), and Together Against Cancer (secretary, 2018, and committee member, 2019). All other authors declare no competing interests.

Data sharing

Data for this study are available upon reasonable request from the principal investigator (NB-P).

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ACTION Study Group

Phetsamone Arounlangsy (Lao Cancer Center, Laos), Soledad L. Balete (Jose R Reyes Memorial Medical Centre, Philippines), Bounthaphany Bounxouei (Mahosot Hospital, Laos), Dieu Bui (K Hospital, Vietnam), Jay Datukan (St Luke's Medical Centre, Philippines), Agnes E Gorospe (St Luke's Medical Centre, Philippines), Prasit Khopaibul (Suratthani Cancer Centre, Thailand), Thanut Khuayjarernpanishk (Ubonratchathani Cancer Centre, Thailand), Thiravud Khuhaprema (National Cancer Institute of Thailand, Thailand), Myo Khin (Department of Medical Research, Myanmar), Tawin Klinwimol (Ubonratchathani Cancer Centre, Thailand), Somkiet Lalitwongsa (Lampang Cancer Hospital, Thailand), Dhanoo Lawbundis (Lopburi Cancer Hospital, Thailand), Conrado Lola (National Kidney and Transplant Institute, Philippines), Gloria Cristal-Luna (National Kidney and Transplant Institute, Philippines), Leo Marbella (National Kidney and Transplant Institute, Philippines), Soe Oo Maung (Yangon General Hospital, Myanmar), Shu Mon (Bahosi Hospital, Myanmar), Win Pa Pa Naing (Department of Medical Research, Myanmar), Annielyn Beryl Ong-Cornel (Veterans Memorial Medical Centre, Philippines), Khin May Oo (Department of Medical Research, Myanmar), Irisyl Orolfo-Real (Philippine General Hospital, Philippines), Dung Pham Xuan (Oncology Hospital, Vietnam), Seang Pharin (Calmette Hospital, Cambodia), Pujianto (Universitas Indonesia, Indonesia), Oudayvone Rattanavong (Mahosot Hospital, Laos), Kouy Samnang (Khmer–Soviet Friendship Hospital, Cambodia), Somphob Sangkittipaiboon (Lopburi Cancer Hospital, Thailand), Cherelina Santiago-Ferreras (Veterans Memorial Medical Centre, Philippines), Prih Sarnianto (Universitas Indonesia, Indonesia), San Shwe (Department of Medical Research, Myanmar), Eav Sokhaai (Calmette Hospital, Cambodia), Thanadej Sinthusake (Mahavajiralongkorn Thanyaburi Hospital, Thailand), Darunee Suanplu (Suratthani Cancer Hospital, Thailand), Hasbullah Thabrany (Universitas Indonesia, Indonesia), Kitisak Thepsuwan (Chonburi Cancer Hospital, Thailand), Yin Yin Htun (No 2 Military Hospital, Myanmar), Heng Viroath (Khmer–Soviet Friendship Hospital, Cambodia), Le Le Win (Department of Medical Research, Myanmar), Swe Swe Win (University of Dental Medicine, Myanmar), Tin Moe Win (Mandalay General Hospital, Myanmar), Ami Ashariati (Soetomo Hospital, Indonesia), Djumhana Atmakusuma (Cipto Mangunkusumo Hospital, Indonesia), I Made Bakta (Sanglah Hospital, Indonesia), Dang Thi Kim Loan (Oncology Hospital Ho Chi Minh, Vietnam), Dang Thi Ngoc Phung (Oncology Hospital Ho Chi Minh, Vietnam), Tuan Diep Bao (Oncology Hospital Ho Chi Minh, Vietnam), Ario Djatmiko (Surabaya Oncology Hospital, Indonesia), Andi Fachruddin (Wahidin Hospital, Indonesia), Pik-Pin Goh (National Clinical Research Centre, Malaysia), Johan Kurnianda (Sardjito Hospital, Indonesia), Helen Monaghan (The George Institute for Global Health, Australia), Abdul Muthalib (Medistra Hospital, Indonesia), Trang Ngo Thuy (Bach Mai Hospital, Vietnam), Thao Nguyen Hoang, (K Hospital, Vietnam), Nguyen Thi Hoai Nga (K Hospital, Vietnam), Sonar S Panigoro (Dharmais Cancer Center Hospital, Indonesia), Huy Pham Quang (K Hospital, Vietnam), Khanh Quach Thanh (Oncology Hospital Ho Chi Minh, Vietnam), Dradjat R Suardi (Hasan Sadikin Hospital, Indonesia), Aru W Sudoyo (MRCCC Siloam Hospital, Indonesia), Khoa Tran Dang (Ha Noi Oncology Hospital, Vietnam), Ha Tran Dinh (Bach Mai Hospital, Vietnam), Catharina Suharti (Karyadi Hospital, Indonesia), Suyatno (Adam Malik Hospital, Indonesia), and Mark Woodward (The George Institute for Global Health, Australia).

Study sites

Cambodia: Calmette Hospital (Phnom Penh) and Khmer–Soviet Friendship Hospital (Phnom Penh). Indonesia: Adam Malik Hospital (Medan), Cipto Mangunkusumo Hospital (Jakarta), Dharmais Cancer Center Hospital (Jakarta), Hasan Sadikin Hospital (Bandung), Karyadi Hospital (Semarang), Sanglah Hospital (Denpasar), Sardjito Hospital (Yogyakarta), Soetomo Hospital (Surabaya), Wahidin Sudirohusodo Hospital (Makassar), and Surabaya Oncology Hospital (Surabaya). Laos: Mahosot Hospital (Vientiane). Malaysia: Hospital Ampang (Ampang), Hospital Kuala Lumpur (Kuala Lumpur), Hospital Melaka (Melaka), Hospital Queen Elizabeth I (Kota Kinabalu), Hospital Raja Perempuan Zainab II (Kota Baru), Hospital Seri Manjung (Seri Manjung), Hospital Sibu (Sibu), Hospital Sultanah Aminah (Johor Bahru), Hospital Sungai Buloh (Sungai Buloh), Hospital Tengku Ampuan Rahimah (Klang), Hospital Tuanku Fauziah (Kangar), Hospital Wanita dan Kanak-Kanak Sabah (Likas), Sime Darby Medical Centre (Subang Jaya), National Clinical Research Centre (Kuala Lumpur), University Malaya Medical Centre (Kuala Lumpur), and University Malaya Specialist Centre (Kuala Lumpur). Myanmar: Bahosi Hospital (Yangon), Mandalay General Hospital (Mandalay), No 2 Military Hospital (Yangon), University of Dental Medicine (Yangon), and Yangon General Hospital (Yangon). Philippines: Jose R Reyes Memorial Medical Centre (Manila), University of the Philippines–College of Medicine, Philippine General Hospital (Manila), National Kidney and Transplant Institute (Quezon City), St Luke's Medical Centre (Quezon City), and Veterans Memorial Medical Centre (Quezon City). Thailand: Chonburi Cancer Hospital (Chonburi), Lampang Cancer Hospital (Lampang), National Cancer Institute of Thailand (Bangkok), Lopburi Cancer Hospital (Lopburi), Mahavajiralongkorn Thanyaburi Hospital (Pathumthani), Suratthani Cancer Centre (Suratthani), and Ubonratchathani Cancer Hospital (Ubonratchathani). Vietnam: Bach Mai Hospital (Hanoi), K Hospital (Hanoi) and Oncology Hospital Ho Chi Minh (Ho Chi Minh).

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