Knowledge, attitude and practices on dengue fever among paediatric and adult in-patients in Metro Manila, Philippines

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ABSTRACT

Background: Knowledge, attitude and practice (KAP) studies have included mainly community-based samples, yet, investigation on in-patients with Dengue fever (DF) through hospital-based surveillance has not been done.

Methods: This study aimed to assess and compare the KAP, identify its determinants and protective factors among 250 clinically or serologically confirmed paediatric (n = 233) and adult patients (n = 17) with DF and 250 youth (n = 233) and adult (n = 17) controls.

Results: Paediatric patients with DF had significantly higher knowledge ($P < 0.05$) and practice ($P < 0.05$) domains mean scores than adult patients with DF and significantly lower practice mean scores than youth controls ($P < 0.05$). Being senior high school, days in the hospital and rash determined increased KAP among paediatric patients with DF while no significant determinants were found among adult patients with DF. Mosquito-eating fish, screen windows and Dengue vaccine were protective factors against DF, though, further studies should confirm these results. Moreover, there was a significant positive correlation between knowledge and attitude ($P < 0.01$) of paediatric patients with DF, however, similar with adult patients with DF, these domains did not correlate with their practices against DF.

Conclusion: This suggests that the translation of knowledge and attitude to better practices against DF was poor. Thus, it is necessary to structure health programs on models that facilitate behavioural change among children and adults.

Keywords:

Dengue fever, behavioural change, protective factors

Background

To date, there has been no known cure for Dengue Fever (DF), the world's fastest spreading mosquito-borne disease which causes approximately 390 million cases per year and puts an estimated 3.9 billion people at risk in 128 countries [1-3]. Since DF epidemiology and ecology are strongly associated with human habits and activities [4], community-based studies have been done to assess the knowledge, attitude and practices (KAP) of people on DF.

Several community-based KAP studies have investigated the correlation among KAP domains. Harapan et al. [5] reported that good knowledge is positively associated with good practice. This is parallel to the report by Alyousefi et al. [6] that poor knowledge on DF has significant positive association with poor preventive practices. However, other similar studies had different results. Kumaran et al. [7] and Shuaib et al. [8] reported that knowledge on causes, signs, symptoms, mode of transmission and preventive practices against DF is not correlated with the practice of preventive measures against DF. Aside from these, two case-control studies reported which preventive practices are protective factors against DF. Regression models revealed that removing trash and stagnant water from around the residence, using mosquito repellent oils, use of mosquito bed nets, fumigation inside the house, and piped water inside the house can reduce the risk and vulnerability to DF infection [9, 10].

Most of the KAP studies have included only community-based samples and investigation on hospital-based samples with clinical or serologically-confirmed DF diagnosis has not been done. Chen et al. [9] interviewed patients who were randomly sampled from a web-based reporting system through telephone interviews. However, this method limits the collection to individuals and households with telephones. It also had 50% response and completion rate among respondents [10, 11]. On the other hand, face to face interview with questionnaire would obtain good response and acceptance rate (99%) and a low refusal rate (1%) among in- and out-patients [11, 12]. Kenneson et al. [10] also did clinical ascertainment and community screening to interview households with and without DF infections by identifying acute or recent DF infections. However, the data collected among households with acute or recent DF infections suggested self-report bias, as members of these households may have already acquired knowledge, changed their behaviour or attitude towards DF during their surveillance [10]. Therefore, hospital-based surveillance, compared with community-based surveillance, would allow us to capture patients' knowledge and attitude and their family's/household's practices against DF during hospitalization (acute phase [febrile-critical] of the infection [2-7 days] from the onset of fever [1]).

Previous KAP studies have also reported that sociodemographic data like income, employment, education, marital status, religion, sex, age, location, socio-economic status, type of residence and DF history were associated with KAP [5, 8, 13-21]. However, to our knowledge, no study has investigated the association between clinical parameters (e.g. diagnosis, platelet count), clinical symptoms (e.g. fever, rash, abdominal pain) and KAP, more so, the difference of determinants of KAP between paediatric and adult patients with DF. Since adults exhibit higher incidence of the severe forms of DF compared with children [22], clinical presentations of symptoms may also be significantly different between paediatric and adult patients with DF. Vomiting and skin rash were more prevalent among children while myalgia and arthralgia, nausea, thrombocytopenia were more exhibited by adult patients with DF [22, 23].

Based on the literatures presented, we hypothesized that paediatric and adult patients' knowledge and attitude on DF would not have significant positive relationship with their practices against DF, compared with the youth and adult controls. We also hypothesized that paediatric and adult patients with DF may have different determinants of KAP by socio-demographic profile like age, gender and education. In addition, clinical symptoms as determinants of KAP will be different between paediatric and adult patients with DF. Vomiting and skin rash would determine high KAP among paediatric patients with DF while myalgia and arthralgia, nausea, thrombocytopenia would de determinants of high KAP among adult patients with DF. With all these, we hypothesized that paediatric and adult patients with DF would have lower levels of KAP domains than the youth and adult controls, which would also give us hints on which KAP domain have aggravated the acquisition of the infection. Therefore, this study aimed to assess and compare the KAP of paediatric patients and adult patients with DF, paediatric patients with DF and youth control and adult patients with DF and adult controls. We also sought to identify the determinants of KAP domains by socio-demographic profiles, clinical parameters and symptoms, analyse the relationship among the KAP domains, and identify protective factors against DF.

Methods

Study and Sampling Design

This study used a non-probability purposive sampling method among patients with DF admitted in 3 public tertiary (>100 beds) hospitals in Metro Manila, Philippines: San Lazaro Hospital, a referral facility for Infectious/ Communicable Diseases, Quezon City General Hospital and; Pasay City General Hospital during the rainy season from 26th July to 26th November 2017. A sample size of 355 was recommended to assume that 50%

of patients had good KAP on DF, with a 5% margin of error, 95% CI (a = 0.05; critical value/Z-score of 1.96) based on 4,525 cases in Metro Manila, Philippines, during the same period in 2016 [24]. The number of DF cases increased by 15.5% in Metro Manila from January 1 to May 6 (morbidity week 1–18), which was one of the highest rates in the country in 2017 [25]. For the controls, we followed the 1:1 ratio (one case patient/ one control) with an assumed odds-ratio of ≥2, power (1-β) of 0.80, 0.05 significance level, Z_{α}=1.96 [26].

Participant Inclusion and Exclusion Criteria

A semi-structured bedside interview was done among paediatric (<19 years old) and adult in-patients (age >18 years old) with serology-confirmed or clinically diagnosed DF, who were conscious and able to read and write. Excluded were those who were not able to comply with consent procedures, or with life-threatening comorbidities. Controls were randomly sampled individuals who had no signs and clinical symptoms of DF and who had no family member hospitalized for or diagnosed with DF at the time of interview. Community-based controls were compared with adult patients with DF while paediatric patients with DF were compared (8 to 18 years old) with school-based Grade 3 to Grade 12 students.

Ethical Considerations

The study was written and conducted based from international and local ethical guidelines: Declaration of Helsinki, ICH-GCP Guidelines and National Ethical Guidelines for Health Research [27-29]. It was reviewed and approved by the Institutional Ethics and Review Boards (IERBs) of each participating hospital: Research Ethics and Review Unit of San Lazaro Hospital, Research Ethics and Technical Committee of Pasay City General Hospital and Planning, Development, Education and Research office of Quezon City General Hospital. Informed consent was obtained from all the controls and patients and/or their parent or legally authorized representative (LAR), or caregiver, especially of those who were under 18 years old.

Forms and Instruments

Socio-demographic Profile, Clinical Parameters and Symptoms. Both patients and controls were asked about their personal information like age, civil status, gender, educational attainment or employment status, and family monthly income and family and self DF history. Patients' clinical parameters like admitting diagnosis, serologic test results (NS1Ag and BLOT: IgG and IgM) and laboratory data (*i.e.,* CBC with platelet count) were

120 obtained from medical charts which were used to identify their current DF phase (acute: febrile to critical and
121 recovery phase). Clinical symptoms or chief complaints were also asked.
122 KAP about DF was developed by Shuaib et al. [8] in Jamaica which was pretested and completed three
123 Delphi Method review rounds for question and response construction and purpose of the questionnaire. The
124 survey has 3 domains: 29-item knowledge (dengue symptoms, modes of transmission, preventive practices and
125 disease management), 3-item attitudes (seriousness, risk and prevention) and 12-item practices (mosquito-man
126 contact and eliminating breeding sites) [8]. Knowledge and attitude domains pertain to each participant's self-
127 report of knowledge and perception towards DF, while the practice domain involves each participant's
128 household-report of the preventive practices against DF. We added two items in the list of sources of
129 information (e.g. social media and "barangay" or villages and community) and 1 item in practice (e.g. dengue
130 vaccine). A three-point scale, "yes", "no" and "I don't know" was used in knowledge domain. Correct responses
131 were coded 1, otherwise, coded 0 [18]. A 5-point scale, "strongly agree" to "strongly disagree" was used to
132 identify participants' attitudes where "strongly agree" scored 2 and "agree" scored 1. Likewise, one item in
133 practices (frequency of cleaning ditches and containers with water) used 4-point scale of "always" to "never"
134 where "always", "often", "sometimes" were scored 3, 2 and 1, respectively. For more information on the
135 permission acquisition and translation and validation procedures of the questionnaire, please see Additional File
136 1.

137 **Statistical and Data Analysis**

138 Statistical analysis was done using Statistical Package for Social Sciences (SPSS) version 25 (IBM Corp.,
139 Armonk, NY). We compared the groups: paediatric and adult patients, youth and adult controls, paediatric
140 patients and youth controls, and adult patients and adult controls by their mean scores in each KAP domain
141 using independent samples t-test. To identify determinants (socio-demographic profiles, clinical parameters and
142 clinical symptoms) of KAP, we did a multiple linear regression analysis. It was conducted by inputting socio-
143 demographic and clinical variables (dummy variables [i.e., 0 or 1] for categorical variables) in the model using a
144 stepwise method in backward selection to identify significant ($P < 0.05$) determinants of KAP. We also calculated
145 the difference in the proportion of participants (yes vs. no) in each source of information using chi-square test.
146 Then, we compared their mean scores in each source of information to identify which increases KAP levels by
147 using independent t-test. To calculate the correlation values between the KAP domain scores, Spearman's rank

148 correlation (r_s) (two-tailed) and the fisher's R-to-Z transformation to obtain confidence interval (CI) were used
149 for the not normally distributed scores as shown by the Shapiro-Wilk and Kolmogorov-Smirnov normality tests
150 [18]. All preventive practices were used in a logistic regression analysis to identify protective factors against DF
151 infection in youth and adult samples. All significant factors ($P < 0.05$) were put in the multiple regression analysis
152 using stepwise backward selection method.

153 **Results**

154 **Socio-demographic Profile, Clinical Parameters and Symptoms**

155 Initially, there were 350 patients with DF participated in the study. However, we have excluded those
156 who had incomplete responses (n = 15, 4.3%) and those whose responses came from a family member instead
157 of the patient himself (n = 85, 24.3%). Thus, data from 500 participants comprising of 250 patients with DF
158 (paediatrics n = 233 [93.2%]; adults n = 17 [6.8%]) and 250 controls (youth n = 233; adults n = 17) were included
159 in the final analysis. Paediatric patients with DF had a mean (M) age of 13, and an SD (±) of 3.16 years. All were
160 single (100%), 56.7% were males, and 46.9% were in junior high school, 84% belong to a family with a monthly
161 income of ≤10,000 pesos. The age of adult patients ranges from 19 to 49 years old (M, 29.9±10), 64.7% were
162 females; 73.3% were single, 61.5% were employed, 70.6% belong to a family with a monthly income of ≤10,000
163 pesos and 70.6% belong to a family with ≤5 members. All (100%) adult patients and majority (77.7%) of
164 paediatric patients with DF had dengue with warning signs. A large proportion of paediatric patients and adult
165 patients had no DF history (92.7% and 93.3%, respectively), had no family DF history (69% and 88.2%,
166 respectively) and were in the acute (febrile-critical) phase of the infection (80.7% and 70.6%, respectively). More
167 than half (68.2%) of paediatric patients and majority (88.2) of adult patients had thrombocytopenia (9,900/mm^3).
168 Nearly half (43%) of paediatric patients and 35.3% of adult patients had petechiae or rashes.

169 Furthermore, youth controls had a mean age of 14.11 (±1.88) years with almost half (47.6%) belong to
170 14-16 age group while adult controls had a mean age of 26.6 (±6.07) years which range from 20 to 46 years old.
171 Half (51.1%) of youth controls were males while 64.7% of adult controls were females. All (100%) of youth
172 controls and majority (94.1%) of adult controls were single. Most of the youth (92.7%) and adult controls (93.8%)
173 belong to a family with a monthly income of ≥10,000 pesos. There was a preponderance of youth (86.7%) and
174 adult (94.1%) controls who had no DF history. More than half of youth (79.4%) and adult controls (58.8%) had

175 no family DF history. For more information on the profile of patients with DF and controls, please see Additional
176 file 2: Table S1.

177 **Prevalence of good knowledge, attitudes and practices**

178 An independent samples t-test revealed that paediatric patients (PP) obtained significantly higher mean
179 scores than adult patients (AP) in knowledge (P = 0.03) and practice (P = 0.02) domains as shown in **Figure 1.** In
180 control group, adult controls (AC) had significantly higher mean scores than youth controls (YC) in all domains:
181 knowledge (P < 0.001), attitude (P < 0.001) and practice (P = 0.02). When we compared the mean scores of KAP
182 domains between paediatric patients with DF and youth controls, the former had significantly higher mean
183 scores than the latter in knowledge (P < 0.001) and attitude (P < 0.001) domains. As expected, paediatric patients
184 with DF obtained lower mean score than youth controls in practice domain (P = 0.03) and adult patients with DF
185 had significantly lower mean scores than adult controls in knowledge (P < 0.001) and practice (P < 0.001)
186 domains.

187 **Determinants of knowledge, attitudes and practices**

188 Multiple linear regression analysis found significant regression equations in all KAP domains among
189 paediatric patients with DF as shown in **Table 1**. It showed that knowledge increased significantly more in
190 paediatric patients with DF who were senior high school while it decreased significantly more in paediatric
191 patients who were in college and those who had DF for the first time. Being senior high school also tended to
192 increase paediatric patients' attitude. Then, as their days in the hospital increases, their attitude scores also
193 increase, however, as their age increases, their attitude score decreases. Further, practice scores tend to
194 decrease among those with severe dengue, however, it tends to increase to those paediatric patients who had
195 petechiae or rash. Age was found to increase knowledge, attitude and practice, being female increased both
196 knowledge and attitude and having family DF history increased attitude among youth controls. While no
197 significant determinants were found among adult patients with DF, being in college or university, being female
198 and being in a family with more than 5 members decreased attitude and being unemployed and having DF for
199 the first time, decreased practice among adult controls.

200 **Correlation among knowledge, attitudes and practices**

201 Spearman rank correlation revealed that there was a significant positive correlation between
202 knowledge and attitude domains of paediatric patients with DF as shown in **Table 2**. However, as hypothesized,
203 there was no correlation found in knowledge-practice and attitude-practice domains of both paediatric and
204 adult patients with DF. Among controls, only youth controls had obtained significant positive correlations among
205 the KAP domains, wherein a strong correlation was found between knowledge-practice domains with a
206 correlation coefficient of 0.42 (95% CI: 0.34-0.57).

Table 1. Multiple linear regression results showing the determinants of KAP among patients with DF and controls

Outcome Variables		Determinants	R^2	β	*p-value*
Knowledge	Paediatric patients	Education (senior high school)	0.09	0.18	0.01
		Education (college)		-0.16	0.02
		No DF history (first-time)		-0.15	0.04
	Youth controls	Age	0.18	0.38	< 0.001
		Female		0.19	0.002
Attitude	Paediatric patients	Age	0.11	-0.30	0.004
		Education (senior high school)		0.39	< 0.001
		Days in the hospital		0.16	0.04
	Youth controls	Age	0.09	0.19	0.003
		Female		0.16	0.01
		Had family DF history		0.14	0.03
	Adult Controls	Education (college)	0.63	-0.48	0.01
		Female		-0.48	0.01
		Family members (> 5)		-0.38	0.04
Practice	Paediatric patients	Severe dengue	0.07	-0.15	0.04
		Rash or petechiae		0.18	0.01
	Youth controls	Age	0.06	0.24	< 0.001
	Adult controls	Unemployed	0.57	-0.92	< 0.001
		No DF history (first-time)		-0.58	0.008

β = standardized beta coefficients; DF = dengue fever

218

219 **Sources of information on DF**

220 Television (TV) was the main source of information among patients with DF (75.2%) and controls (72%).
221 Chi-square test analyses showed that paediatric and adult patients with DF were more likely to get information
222 on DF from hospital, doctors and nurses (68.8%, P < 0.001) and health centres (64%, P < 0.001), compared with
223 youth and adult controls. More than half of youth (60.5%) and adult controls (53%) identified social media (e.g.
224 Facebook, Twitter, Instagram etc.) (60 %, P < 0.001) and family members (63% and 59%, P < 0.001) and school
225 (55.8% and 52.9%, P 0.04) as their sources of information about DF. Further analysis of mean score comparisons
226 using independent t- test found that paediatric and adult patients who reported to have obtained information
227 on DF through newspaper and health centre, respectively, had higher knowledge mean scores. In youth controls,

228 those who have obtained information on DF through social media, newspaper, health brochures, family
229 members, school, hospital, doctors and nurses and health centres had higher mean scores in knowledge domain.
230 Attitude and practice mean scores were higher among those paediatric patients with DF and youth controls who
231 had identified newspaper, health brochures, family, school, hospital, doctors and nurses, barangay and
232 community and health centres as their sources of information on DF. Adult controls who reported neighbours
233 as their source of information on DF also had high attitude mean scores and those who had high practice mean
234 scores reported barangay and community and workplace as their sources of information on DF. (Additional file
235 3: Table S2).

Table 2. Correlation between the KAP domains among patients with DF and controls

Patients with DF			Controls		
Variables	**r_s (95%CI)**	***p-value***		**r_s (95%CI)**	***p-value***
Knowledge-attitude					
Paediatric	0.20 (0.08, 0.13)	0.002	Youth	0.34 (0.24-0.48)	< 0.001
Adult	0.02 (-0.51, 0.59)	0.95	Adult	-0.05 (-0.50, 0.60)	0.84
Knowledge-practice					
Paediatric	0.06 (-0.06, 0.20)	0.36	Youth	0.42 (0.34-0.57)	< 0.001
Adult	-0.39 (-0.81, 0.24)	0.12	Adult	0.03 (-0.58, 0.52)	0.91
Attitude-practice					
Paediatric	-0.04 (-0.15, 0.10)	0.57	Youth	0.23 (0.13-0.38)	< 0.001
Adult	-0.13 (-0.62, 0.48)	0.62	Adult	0.19 (-0.41, 0.68)	0.46

r_s: Spearman rank correlation coefficients; 95% Confidence intervals (CI) were transformed using Fisher's R-to-Z

236 **Practices against DF**

237 All preventive practices were used in a logistic regression analysis to identify protective factors against
238 DF. Then, after a multivariate regression analysis, use of mosquito eating fish, Dengue vaccine, use of screen
239 windows, and doing at least one preventive practice against DF were found to be protective factors against DF
240 among youth samples (paediatric patients with DF and youth controls) as shown in **Table 3**. Among adults (adult
241 patients with DF and adult controls), only the use of screen windows was identified as a significant protective
242 factor against DF with adjusted odds-ratio (aOR) of 23.9 (95% CI: 2.08-275.2, P = 0.01). For both youth and adult
243 samples, mosquito eating fish, screen windows, and Dengue vaccine were identified as protective factors against
244 DF infection. The strongest factor in the model was use of mosquito eating fish, with an adjusted ratio (aOR) of
245 8.69 (95% CI: 3.67-20.57, P = < 0.001).

Table 3. Multiple logistic regression model of predictors of absence of DF infection

	Likelihood Ratio Estimates					
Practices	**DF**	**β**	**SE**	**Wald X^2**	**aOR (95% CI)**	**p-value**
Youth						
screen windows	1	1.45	0.31	21.15	4.25 (2.29-7.88)	< 0.001
eliminate standing water	1	-1.40	0.41	11.96	0.24 (0.11-0.54)	0.001
mosquito eating fish	1	2.03	0.45	20.70	7.62 (3.18-18.3)	< 0.001
does nothing to reduce mosquitoes	1	0.98	0.37	6.87	2.67 (1.28-5.57)	0.009
Dengue vaccine	1	1.60	0.28	32.58	4.95 (2.86-8.56)	< 0.001
covering water containers	1	-2.32	0.53	19.15	0.10 (0.03-0.28)	< 0.001
Adults						
professional pest control	1	1.82	0.93	3.88	6.20 (1.01-38.1)	0.05
screen windows	1	3.17	1.25	6.49	23.9 (2.08-275)	0.01
Both						
screen windows	1	1.53	0.30	25.92	4.60 (2.56-8.28)	< 0.001
eliminate standing water	1	-1.41	0.39	13.20	0.24 (0.11-0.52)	< 0.001
mosquito-eating fish	1	2.16	0.44	24.23	8.69 (3.67-20.6)	< 0.001
does nothing to reduce mosquitoes	1	0.70	0.36	3.83	2.01 (1.00-4.04)	0.05
Dengue vaccine	1	1.49	0.27	30.32	4.42 (2.61-7.55)	< 0.001
covered water containers	1	-2.01	0.49	17.09	0.13 (0.05-0.35)	< 0.001

DF = degree of freedom; β = standardized bet coefficients; Wald X^2 = Wald chi-square; aOR (95% CI) = adjusted odds-ratio 95% confidence interval

Discussion

There was a positive correlation found between knowledge and attitude domains of paediatric patients with DF. These indicate that there was a good translation of knowledge to attitude on DF among paediatric patients with DF. Their knowledge on dengue symptoms, modes of transmission, preventive practices against DF and disease management tend to have changed their beliefs that DF is a serious and threatening disease. Although paediatric patients' knowledge correlated with their attitude towards it, both knowledge and attitude did not correlate with their practices against DF. These findings clearly signify that the translation of knowledge and attitude to practice among paediatric patients were poor. This was also found to be true among adult patients with DF, their knowledge and attitude on DF was not correlated with their practices as well. This means that although paediatric and adult patients with DF were knowledgeable about the symptoms of DF, vector breeding sites control, transmission modes of DF, and perceived DF as a serious and threatening disease, it did not lead to change in their behaviour of doing the preventive practices against it. This implies that the poor practice against DF might have exposed them to higher risk of contracting the disease.

The results suggest that health programs should be designed for children and adolescents which focus on translating their knowledge and attitudes into better and effective practices against DF through behaviour change. Many programs continue to focus only on changing people's knowledge and on raising awareness, rather than physical activity programs which are more successful at producing behaviour change [30]. The Communication for Behavioural Impact (COMBI), a comprehensive strategy that uses communication for

264 knowledge to have significant effect to behavioural change (making people becoming aware, informed,
265 convinced, and deciding to act, then repeating and maintaining that action) or increased practices against DF
266 [7,31]. Moreover, another model that facilitates behavioural change that could increase the translation of
267 attitude to practice among children and adolescents is the Health Belief Model (HBM). This model suggests that
268 a change in the behaviour or acting can be expected if a person perceives themselves to be at risk or susceptible
269 to the disease (perceived susceptibility), that the disease will have serious consequences (perceived severity), a
270 course of action will minimize consequences (perceived benefits), and the benefits of action will outweigh the
271 cost of barriers (perceived barriers) and self-efficacy [32]. Both models should on changing the behaviour not
272 only in individual and household levels but also in community level because community participation, including
273 schools, especially children, is necessary to effectively control the vector mosquitoes [33].

274 Previous studies have reported that there is a significant positive correlation between education and
275 level of knowledge and attitude toward DF [17, 21]. However, in our study, paediatric patients who were senior
276 high school tend to have increased knowledge and attitude on DF, compared to those in college or university.
277 One possible reason could be senior high schools may have included contents about DF in their curriculum that
278 may have increased the knowledge and attitude levels of paediatric patients in senior high school. Having DF
279 history was also found to be a significant determinant of high knowledge mean scores among paediatric patients
280 with DF. It may appear obvious; however, past experiences such as infection, which is prevalent among children
281 [28] increased paediatric patients' knowledge about it. Moreover, as expected, age was found to increase
282 knowledge, attitude and practices among youth controls, however, in attitude domain, the opposite was found
283 among paediatric patients with DF. As the age of paediatric patients with DF increases, their attitude towards
284 DF decreases. Hospitalized younger children were reported to be very conscious about their health and express
285 very positive health attitudes than older children [34,35]. This may be brought about by the fact that younger
286 children who are hospitalized are more vulnerable to emotional upset and they experience greater anxieties,
287 arising from separation from parents [36, 37].

288 Another significant determinant of attitude towards DF was the number of days in the hospital.
289 Paediatric patients who identified hospital, doctor and nurses (70%) and health centres (65%) as their sources
290 of information on DF, had significantly higher attitude mean scores than those who didn't identify these as their
291 sources of information on DF. This implies that the longer they stay in the hospital, the more they perceive DF
292 as serious and threatening which may be due to their experience of anxiety towards medical settings and

293 receiving of medical care [38], especially fear of medical procedures like injection needles [39] (daily drawing of
294 blood to check their platelet counts) and they perceive medical professionals like doctors and nurses as inflictors
295 of trauma [40]. Aside from these, hospitalization also increases the chance of children to be dissatisfied with
296 their hospital-stay situations like food conditions [41]. Paediatric patients with DF were advised to avoid eating
297 dark coloured foods (to monitor the colour of stool for signs of bleeding) [42]. Hospitalized children also
298 experience anxiety because of limited physical activities like being absent in school, limited chance of spending
299 time and playing with peers and friends or siblings [43].

300 Petechiae or rash was found to be a significant determinant of attitude among adult patients with DF.
301 As one of the common (35.3%) reported symptoms among adult patients with DF in this study, this implies that
302 those who had petechiae or rashes were more likely to gain belief that DF is a serious illness and anyone is at
303 risk of it. These cause itching and swelling of the palms/soles [44] and its presence may signify severity of the
304 disease as it is the most seen and observed among the symptoms which would have triggered the high attitude
305 level toward DF among adult patients. One possible reason why petechiae or rash was a significant determinant
306 of attitude among adult patients with DF, and not among paediatric patients with DF, was its high prevalence
307 among paediatric patients with DF, compared with adult patients with DF [23]. Thus, the presence of this
308 symptom didn't affect the perception of paediatric patients toward DF, instead, the time when it appeared may
309 explain, in partial, why it was found a significant determinant of practices among paediatric patients with DF.
310 The presence of petechial rash (which is also described as “isles of white in the sea of red”) and pruritus (severe
311 itching of the skin) occur towards the end of acute (febrile) phase and the beginning of the recovery phase [1].
312 This could mean that those paediatric patients who were already having rashes during the interview may have
313 already changed their family/household members’ behaviour and started doing the preventive practices against
314 DF, thus, higher practice mean scores. Severe dengue was also a significant determinant of decreased practice
315 among paediatric patients with DF. Paediatric patients with severe dengue, compared to those who had other
316 DF diagnoses, had the significantly lowest mean score in practice domain. 50% of paediatric patients with severe
317 dengue had to be confined in the intensive care unit (ICU). They were interviewed only after ICU confinement
318 which was, on average, the 5th day of hospitalization. The time spent in the ICU might have decreased the
319 opportunity of their family/household members to immediately do the practices against DF, thus, lower practice
320 mean score.

321 The difference between paediatric patients with DF and youth controls can also be seen in their sources
322 of information. Youth controls were more likely to get more information on DF from their family members (63%),
323 social media (e.g. facebook, Instagram, twitter, etc.) (61.3%) and school (56%) compared with paediatric patients
324 with DF. Further analysis showed that youth controls, compared to paediatric patients with DF, have obtained
325 more knowledge on DF through the use of social media, newspaper, health brochures, family members, school
326 and hospital, doctors or nurses. This hints that unlike paediatric patients with DF, youth controls had more access
327 to different sources of information on DF which might have improved their knowledge on DF. For example, social
328 media and the use of smartphones, have been seen to be a novel system for disease epidemiology [45, 46]. It
329 has high acceptance rate among younger population who perceived that it could be an effective strategic health
330 communication effort to raise dengue-related concerns in the future [47]. Newspaper, health brochures, family,
331 hospital, doctors and nurses and school were found to have improved youth controls' knowledge and practice
332 against DF which suggests that these might be effective means to increase not only the knowledge, but also the
333 practices against DF of children.
334 Multiple logistic regression analysis on the practices revealed that use of mosquito-eating fish, use of
335 screen windows and Dengue vaccine were protective factors against DF. Studies have found that larvivorous fish
336 (*Gambusia Affinis*), the common guppy (*Poecilia reticulata*), *Cyprinidae* or Tilapia spp. can be effectively used to
337 control the mosquito population at their larval stages [48-50]. However, our data collected from both patients
338 with DF and controls, through the use of questionnaire is subjective which might have produced false positive
339 responses, in this case, use of mosquito-eating fish. We had no means to confirm if the participants, especially
340 the patients really had mosquito-eating fish at home, thus, future studies should include direct household
341 observation to validate this result. Moreover, in our study, we assumed that the use of screen windows equates
342 to the use of glass windows in airconditioned rooms among controls, especially the youth. Screen and glass
343 windows could be potential ways to reduce DF transmission by the reduced exposures to vectors that enter
344 homes through open windows [9]. These may not have been available to the patients with DF because majority
345 (85.2%) of them belong to households with low monthly family income, thus, increasing their vulnerability to DF
346 infection. However, our data collected from both patients with DF and controls, through the use of questionnaire
347 is subjective which might have produced false positive responses, which we consider one of the limitations of
348 this study. We had no means to confirm if the participants, especially the patients with DF really had mosquito-

349 eating fish at home or had been using screen windows, thus, future studies should include direct household
350 observation to validate these results.

351 Surprisingly, Dengue vaccine was found to be a protective factor against DF among youth samples.
352 Another limitation of this study was, we couldn't rely to the participants' responses about their Dengue vaccine
353 acquisition history. We had no means to confirm whether they got vaccinated or not. Thus, this result may
354 require more intensive studies to whether it could truly be a protective factor against DF infection. The WHO
355 issued a conditional recommendation in April 2016 on the use of the vaccine for highly dengue-endemic areas
356 due to a subset of trial participants who were inferred to be seronegative at time of first vaccination had a higher
357 risk of more severe dengue and hospitalizations from dengue compared to unvaccinated participants. They still
358 recommend preventive practices that combat vector mosquitoes to control and prevent transmission of DF
359 infection [2].

360 **Conclusions**

361 Paediatric patients with DF had significantly higher mean scores in knowledge and attitude than youth
362 controls, who, in turn, had significantly higher mean score in practice domain compared with paediatric patients
363 with DF. Being senior high school, days in the hospital and rash or petechiae determined increased knowledge,
364 attitude and practices, respectively, among paediatric patients with DF. There was a significant positive
365 correlation between knowledge and attitude of paediatric patients with DF while their knowledge and attitude
366 were not correlated with their practices against DF. These suggest that although paediatric patients had high
367 knowledge and attitude on DF, its translation to better practice of preventive measures against DF was poor
368 compared with youth controls. These findings highlight the importance of behavioural change for knowledge
369 and attitude to have significant effect to practices against DF among children through health programs campaign
370 which are structured from COMBI and HBM. This study also adds to the emerging topics on protective factors
371 against DF, such as use of mosquito-eating fish, use of screen windows and Dengue vaccine, however, further
372 studies are needed to confirm these results.

373 To our knowledge, our study is the first to use hospital-based surveillance that investigated the
374 association of clinical data to KAP domains and described the difference of KAP on DF between paediatric
375 patients and adult patients with DF. This is also the first study to use clinical ascertainment through hospital-
376 based surveillance among paediatric and adult patients with DF. Additionally, there was a high response rate

377 (100%) among patients with DF and various dengue diagnoses among paediatric patients with DF at the three
378 tertiary hospitals, allowing an increased generalizability of study findings. One of this study's major limitations
379 was the relatively small sample size of adult patients with DF which limit the generalizability of study findings in
380 this population. Moreover, participating hospitals were public tertiary hospitals, where most patients belong to
381 low-income families. Thus, association of income with the domains was hard to estimate. Finally, only in-patients
382 were included in this study, limiting the analysis to those admitted to hospitals. Therefore, we recommend that
383 future studies also include out-patients to see whether hospitalization is confounding the association between
384 the constructs and dengue infection.

385 **Abbreviations**

386 DF, Dengue fever; KAP, knowledge, attitude and practices; ICH-GCP, International Conference on
387 Harmonization-Good Clinical Practice; LARs, Legally authorized representatives; NS1Ag, Non-structural protein
388 1 antigen; IgG, Immunoglobin G; IgM, Immunoglobin M; CBC, complete blood count; CI, Confidence interval; M,
389 Mean; aOR, Adjusted odds ratio; COMBI, Communication for behavioral impact; HMB, Health belief model; WHO,
390 World health organization

391 **Declarations**

392 **Ethics approval and consent to participate**

393 This study underwent review and was approved by the different institutional ethics research boards (IERBs) of
394 the three hospitals participated in the study: Research Ethics and Review Unit of San Lazaro Hospital, Research
395 Ethics and Technical Committee of Pasay City General Hospital and Planning, Development, Education and
396 Research office of Quezon City General Hospital. Informed consent was obtained from all the patients and their
397 parents, legally authorized representatives (LARs) or caregivers, especially for those who were under 18 years
398 of age and youth and adult controls.

399 **Consent for publication**

400 Not applicable.

401 **Availability of data and materials**

402 The datasets supporting the conclusions of this article are included within the article and its additional files.

403 MS_KAP_AF1.docx Additional file 1: Detailed description of the knowledge, attitude and practices (KAP) on

404 Dengue Fever questionnaire permission acquisition, translation and validation procedures (DOCX 16 KB)

405 MS_KAP_AF2.docx Additional file 2: Profile of pediatric and adult patients with DF and youth and adult controls

406 (DOCX 25 KB)

407 MS_KAP_AF3.docx Additional file 3: Detailed information on the sources of information on dengue fever of

408 pediatric and adult patients with DF and controls. (DOCX 41 KB)

409 **Competing Interests**

410 The authors declare that they have no competing interests.

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415 Author Contributions

416 Author V.H. designed the study, wrote the protocol, conducted the interviews, analysed the data and written

417 this manuscript. Author F.D.G., G.S. & A.C. were assigned as co-investigators in each hospital site and supervised

418 patient recruitment and data gathering. Author A.T. & C.R. provided guidance and comments on the initial drafts

419 of the study protocol including literature review, sampling, data gathering methods and ethical considerations.

420 Author R.R. supervised the interviews, testing and scoring procedures for the controls. Author M.T. worked with

421 V.H. from the submission to approval of study protocol in the hospitals and over-all data gathering procedures.

422 Author K.W. supervised the data gathering and provided guidance and comments on the analysis and the initial

423 drafts of this manuscript. All authors have contributed to and have approved the final manuscript.

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546 **Figure Legends**

547 **Fig. 1 Independent t-test results for the difference of knowledge, attitude and practices domains mean**
548 **scores among paediatric and adult patients with DF and youth and adult controls.** PP = Paediatric Patients,
549 AP = Adult Patients, YC = Youth Controls, AC = Adult Controls; *p < 0.05; **p < 0.01; ***p < 0.001