

## Electronic Supplementary Material

### Association of Allergic Symptoms with Dengue Infection and Severity: A Systematic Review and Meta-analysis

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Supplementary Materials

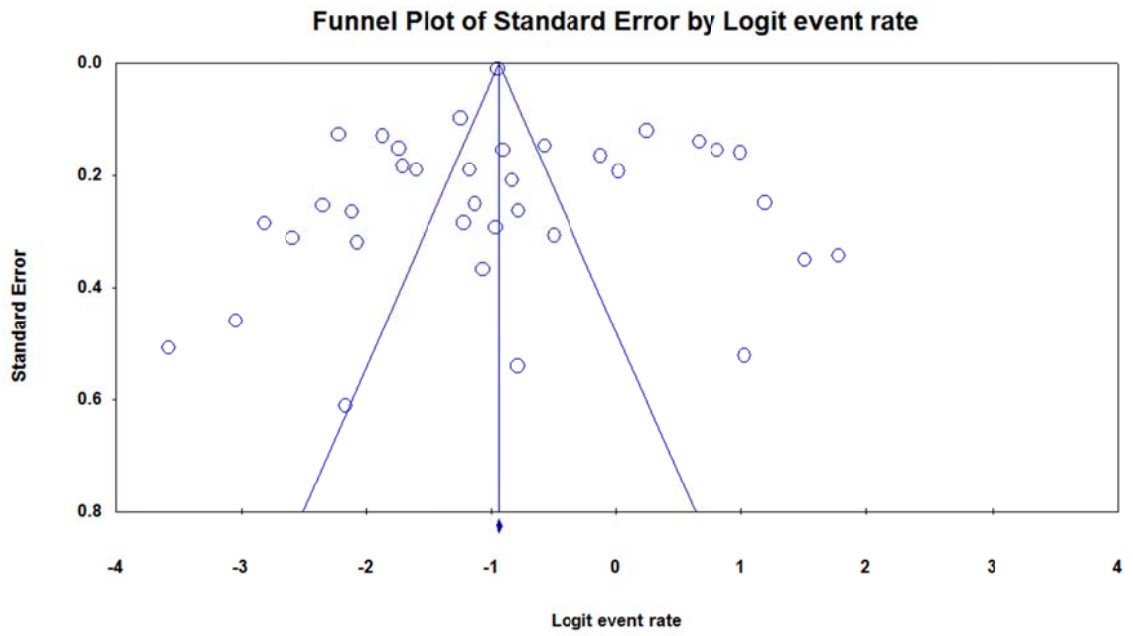


Figure S1: Showing funnel plot for pruritus

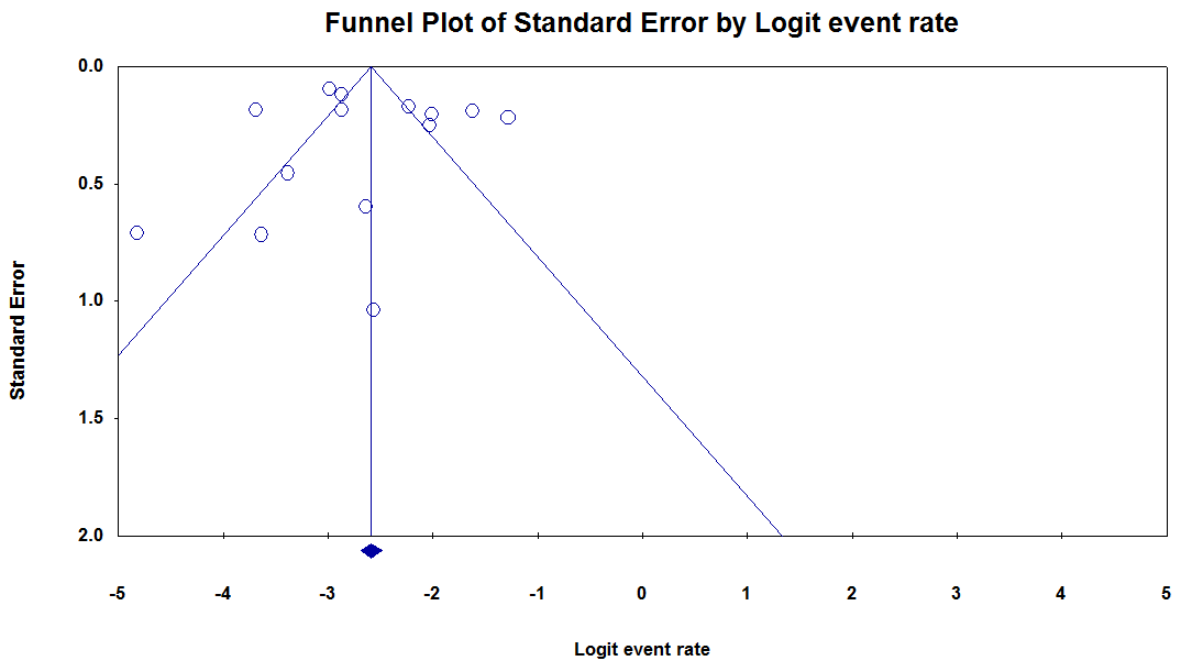


Figure S2: Showing funnel plot for asthma

**Table S1: PRISMA checklist**

Section/topic	#	Checklist item	Reported on page #
<b>TITLE</b>			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	1
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known.	2-3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	3
<b>METHODS</b>			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	3
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	5
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	5
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	5
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	5
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$ ) for each meta-analysis.	5-6
Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	5

Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	6
<b>RESULTS</b>			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	6
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	6
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	6
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	7,8
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	7,8
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	5
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	7
<b>DISCUSSION</b>			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	8
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	11
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	11
<b>FUNDING</b>			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	12

**Table S2: Characteristics of included studies**

Author ID	References	Type of allergic symptoms	Prevalence of allergic symptoms Event/total (%)	Groups by severity	Severity classification	Sample size	Quality Rating
Azfar <i>et al.</i> (2012) in Pakistan	(Azfar <i>et al.</i> 2012)	Pruritus	135/195 (69.2)	DF	NR	300	Fair
Mahmood <i>et al.</i> (2009) in Pakistan	(Mahmood <i>et al.</i> 2009)	Pruritus	51/341 (14.9)	DF+DHF+DSS	NR	341	Fair
Saleem <i>et al.</i> (2008) in Pakistan	(Saleem and Shaikh 2008)	Pruritus	16/70 (22.9)	DF+DHF+DSS	NR	100	Fair
Vega <i>et al.</i> (2006) in Colombia	(Aralí Martínez-Vega <i>et al.</i> 2006)	Pruritus	3/29 (10.3)	DF	NR	29	Fair
Itoda <i>et al.</i> (2006) in Japan	(Itoda <i>et al.</i> 2006)	Pruritus	14/19 (73.6)	DF	NR	62	Fair
Chungue <i>et al.</i> (1992) in France	(Chungue <i>et al.</i> 1992)	Pruritus	69/701 (9.9)	DF	NR	701	Fair
Hochedez <i>et al.</i> (2008) in France	(Hochedez <i>et al.</i> 2008)	Pruritus	5/16 (31.2)	DF	NR	16	Fair
Desruelle <i>et al.</i> (1997) in France	(Desruelles <i>et al.</i> 1997)	Pruritus	10/39 (25.6)	DHF+DF	NR	39	Fair
Deparis <i>et al.</i> (1998) in France	(Deparis <i>et al.</i> 1998)	Pruritus	33/196 (17)	DF+DHF	WHO 1987	298	Fair
Wali <i>et al.</i> (1999) in India	(Wali <i>et al.</i> 1999)	Pruritus	5/110 (4.5)	DHF+DSS	WHO 1986	110	Fair
Kauser <i>et al.</i> (2014) in India	(Kauser <i>et al.</i> 2014)	Pruritus	4/146 (2.7)	DF	NR	146	Fair
Deshwal <i>et al.</i> (2015) in India	(Deshwal <i>et al.</i> 2015)	Pruritus	69/515 (13.4)	DF+DHF+DSS	NR	515	Fair
Thomas <i>et al.</i> (2007) in India	(Thomas <i>et al.</i> 2007)	Pruritus	16/58 (27.6)	DF+DHF+DSS	WHO 1986	124	Fair
Tewari <i>et al.</i> (2013) in India	(Tewari <i>et al.</i> 2013)	Pruritus	13/230 (5.5)	DF+DHF	NR	230	Fair
Nogueira <i>et al.</i> (1995) in Brazil	(Nogueira <i>et al.</i> 1995)	Pruritus	54/107 (50.5)	DF	NR	107	Fair
Vasconcelos <i>et al.</i> (1998) in Brazil	(Vasconcelos <i>et al.</i> 1998)	Pruritus	149/226 (66)	DF	PAN 1994/ WHO 1996	1341	Fair
Tristão-Sá <i>et al.</i> (2012) in Brazil	(Tristão-Sá <i>et al.</i> 2012)	Pruritus	69/90 (76.7)	DF+DHF+DSS	WHO 1997	110	Fair
Daumas <i>et al.</i> (2013) in Brazil	(Daumas <i>et al.</i> 2013)	Pruritus	21/67 (31.3)	DF+DHF+DSS	WHO 1997	69	Fair
Lessa Filho <i>et al.</i> (2008) in Brazil	(Lessa Filho 2008)	Pruritus	69/147 (46.9)	DF+DHF+DSS	WHO 1997	147	Fair

Fujimoto <i>et al.</i> (2014) in Brazil	(Fujimoto and Koifman 2014)	Pruritus	17/194 (8.8)	DHF	NR	193	Fair
Cordeiro <i>et al.</i> (2007) in Brazil	(Cordeiro <i>et al.</i> 2007)	Pruritus	13625/48768 (27.9)	DF+DHF	WHO 1997	48768	Fair
Passos <i>et al.</i> (2008) in Brazil	(Passos <i>et al.</i> 2008)	Pruritus	158/282 (56)	DF+DHF	WHO 1997	453	Fair
Palomeque <i>et al.</i> (2003) in Ecuador	(Palomeque <i>et al.</i> 2004)	Pruritus	21/86 (24.4)	DF	NR	86	Fair
Brown <i>et al.</i> (2004) in Trinidad	(Brown <i>et al.</i> 2004)	Pruritus	11/157 (7)	DF+DHF+DSS	NR	157	Fair
Chen <i>et al.</i> (2017) in Taiwan, China	(Chen <i>et al.</i> 2017)	Pruritus	59/205 (28.8)	DF+DHF+DSS	WHO 2009	205	Fair
Kao <i>et al.</i> (2016) in Taiwan, China	(Kao <i>et al.</i> 2016)	Pruritus	135/603 (22.4)	DF+DHF+DSS	WHO 1997	603	Fair
Campagna <i>et al.</i> (2006) in Portugal	(Campagna <i>et al.</i> 2006)	Pruritus	45/55 (81.8)	DF+DHF+DSS	NR	55	Fair
Caballero <i>et al.</i> (2009) in Paraguay	(Caballero <i>et al.</i> 2009)	Pruritus	59/69 (85.5)	DF	NR	69	Fair
Marrugo <i>et al.</i> (2014) in Columbia	(Gómez Marrugo <i>et al.</i> 2014)	Pruritus	11/98 (11.2)	DF+DHF+DSS	NR	98	Fair
Raman <i>et al.</i> (2013) in Bangladesh	(Raman <i>et al.</i> 2013)	Pruritus	146/200 (73)	DF+DHF+DSS	WHO 2011	200	Fair
Chadwick <i>et al.</i> (2006) in Singapore	(Chadwick <i>et al.</i> 2006)	Pruritus	16/148 (10.8)	DF+DHF	NR	148	Fair
Pino <i>et al.</i> (1993) in Mexico	(Loroño Pino <i>et al.</i> 1993)	Pruritus	72/200 (36)	DF+DHF	NR	200	Fair
Sheikh <i>et al.</i> (2012) in Pakistan	(Sheikh <i>et al.</i> 2012)	Pruritus and Urticaria	33/109 (30.3) 4/109 (3.7)	DF+DHF+DSS	WHO 2009	109	Fair
Rubio <i>et al.</i> (2008) in Cuba	(Rubio <i>et al.</i> 2008)	Pruritus and asthma	35/228 (15.4) 27/228 (11.8)	DF+DHF	PAHO/WHO	228	Fair
Thangaratham <i>et al.</i> (2013) in India	(Thangaratham <i>et al.</i> 2013)	Pruritus and asthma	36/152 (23.7) 5/152 (3.3)	DF+DHF+DSS	WHO 1997	152	Fair
Gupta <i>et al.</i> (2016) in India	(Gupta <i>et al.</i> 2016)	Pruritus and asthma	17/45 (37.8) 3/45 (6.7)	DF+DHF+DSS	WHO 2016	45	Fair
Low <i>et al.</i> (2011) in Singapore	(Low <i>et al.</i> 2011)	Asthma	2/250 (0.8)	DF	NR	250	Fair
Bruce <i>et al.</i> (2016) in Cuba	(Bruce <i>et al.</i> 2016)	Asthma	18/155 (11.6)	DF+DHF+DSS	NR	127	Fair

Guzman <i>et al.</i> (1992) in Cuba	(Guzman <i>et al.</i> 1992)	Asthma	27/124 (21.8)	DHF	WHO 1980	43	Fair
Bravo <i>et al.</i> (1987) in Cuba	(Bravo <i>et al.</i> 1987)	Asthma	35/450 (7.8)	DSS vs fatal	WHO 1980	429	Fair
Pang <i>et al.</i> (2012) in Singapore	(Pang <i>et al.</i> 2012)	Asthma	110/2285 (4.8)	DHF+DF	WHO 1997	2285	Fair
Mahmood <i>et al.</i> (2013) in India	(Mahmood <i>et al.</i> 2013)	Asthma	37/381 (9.7)	DHF+DF	NR	381	Fair
Hechavarria <i>et al.</i> (2001) in Cuba	(Orozco Hechavarria <i>et al.</i> 2001)	Asthma	1/14 (7.1)	DHF+DF	NR	14	Fair
Maria <i>et al.</i> (2010) in Brazil	(Figueiredo <i>et al.</i> 2010)	Asthma and allergy	72/1345 (5.4) 337/1345 (25)	DHF+DF	WHO 1997	1345	Fair
Teixeira <i>et al.</i> (2015) in Brazil	(Teixeira <i>et al.</i> 2015)	Asthma and allergy	61/1806 (3.4) 964/1806 (53.4)	DHF+DF	WHO 1997	1806	Fair
Cortinas <i>et al.</i> (1999) in Cuba	(González Cortiñas <i>et al.</i> 1999)	Asthma and allergy	33/200 (16) 4/200 (2)	DHF	PAHO/WHO	200	Fair
Mukhtar <i>et al.</i> (2008) in Pakistan	(Mukhtar <i>et al.</i> 2012)	Asthma and allergy	2/78 (2.6) 2/78 (2.6)	DF	NR	78	Fair
Cunha <i>et al.</i> (1999) in Brazil	(Cunha <i>et al.</i> 1999)	Allergy	2/21 (9.5)	DHF+DSS	WHO 1986	8105	Fair
Wieten <i>et al.</i> (2012) in Netherlands	(Wieten <i>et al.</i> 2012)	Allergy	5/132 (3.8)	DF	WHO 1997 WHO 2009	581	Fair
Vazquez <i>et al.</i> (2014) in Cuba	(Vazquez <i>et al.</i> 2014)	IgE	NA	DHF+DF	WHO/PAHO 1994	71	Fair
Va'zquez <i>et al.</i> (2004) in Cuba	(Vazquez <i>et al.</i> 2005)	IgE	NA	DHF+DF	WHO1994	168	Fair
Bachal <i>et al.</i> (2015) in India	(Bachal <i>et al.</i> 2015)	IgE	NA	DHF+DF	WHO 2009	220	Fair
Parvi <i>et al.</i> (1979) in India	(Pavri <i>et al.</i> 1979)	IgE	NA	DHF	NR	54	Fair
Mabalarajan <i>et al.</i> (2005) in India	(Mabalarajan <i>et al.</i> 2005)	IgE	NA	DF+DHF+DSS	WHO 1997	88	Fair
Koraka <i>et al.</i> (2003) in Indonesia	(Koraka <i>et al.</i> 2003)	IgE	NA	DF+DHF+DSS	WHO 1997	202	Fair
Míguez-Burbano <i>et al.</i> (1999) in Colombia	(Míguez-Burbano <i>et al.</i> 1999)	IgE	NA	DF+DHF+DSS	NR	168	Fair
Parvi <i>et al.</i> (1977) in India	(Pavri <i>et al.</i> 1977)	IgE	NA	DHF	NR	46	Fair

Abbreviations; DF = dengue fever, DHF = dengue hemorrhagic fever, DSS = dengue shock syndrome, NR = not reported, NA = not applicable.



## References

- Anders KL, Nguyet NM, Chau NVV, Hung NT, Thuy TT, Farrar J, Wills B, Hien TT, Simmons CP (2011) Epidemiological factors associated with dengue shock syndrome and mortality in hospitalized dengue patients in Ho Chi Minh City, Vietnam. *Am J Trop Med Hyg* 84:127-134
- Aralí Martínez-Vega R, Díaz-Quijano FA, Villar-Centeno LA (2006) Dificultad para el diagnóstico clínico temprano del dengue en un área endémica y su impacto sobre el manejo médico inicial. *Revista médica de Chile* 134:1153-1160. (In Spanish)
- Ashburn PM, Caraig CF (1907) Experimental Investigations Regarding the Etiology of Dengue Fever. *The Journal of Infectious Diseases* 4:440-475
- Azfar NA, Malik LM, Jamil A, Jahangir M, Tirmizi N, Majid A, Ashraf M, Malik M (2012) Cutaneous manifestations in patients of dengue fever. *Journal of Pakistan Association of Der-matologists: JPAD* 22:320-324
- Bachal R, Alagarasu K, Singh A, Salunke A, Shah P, Cecilia D (2015) Higher levels of dengue-virus-specific IgG and IgA during pre-defervescence associated with primary dengue hemorrhagic fever. *Arch Virol* 160:2435-2443
- Barber C, Kalichinsky C (2016) A novel combination of an IgE mediated adult onset food allergy and a suspected mast cell activation syndrome presenting as anaphylaxis. *Allergy Asthma Clin Immunol* 12:46
- Begg CB, Mazumdar M (1994) Operating characteristics of a rank correlation test for publication bias. *Biometrics* 50: 1088-1101
- Bhatt S, Gething PW, Brady OJ, Messina JP, Farlow AW, Moyes CL, Drake JM, Brownstein JS, Hoen AG, Sankoh O (2013) The global distribution and burden of dengue. *Nature* 496:504
- Boesiger J, Tsai M, Maurer M, Yamaguchi M, Brown LF, Claffey KP, Dvorak HF, Galli SJ (1998) Mast cells can secrete vascular permeability factor/ vascular endothelial cell growth factor and exhibit enhanced release after immunoglobulin E-dependent upregulation of fc epsilon receptor I expression. *J Exp Med* 188:1135-1145
- Bravo J, Guzman M, Kouri G (1987) Why dengue haemorrhagic fever in Cuba? I. Individual risk factors for dengue haemorrhagic fever/dengue shock syndrome (DHF/DSS). *Trans R Soc Trop Med Hyg* 81:816-820
- Brown JM, Wilson TM, Metcalfe DD (2008) The mast cell and allergic diseases: role in pathogenesis and implications for therapy. *Clin Exp Allergy* 38:4-18
- Brown T, Babb K, Nimrod M, Carrington C, Salas R, Monteil MA (2004) A retrospective study of the 1996 DEN-1 epidemic in Trinidad: demographic and clinical features. *Dengue Bull* 28: 7-19.
- Bruce AA, de la Cruz IG, Chávez SM (2016) Estudio de los pacientes adultos portadores de Dengue severo en un quinquenio. *Tecnosalud*. (In Spanish)
- Butthep P, Chunchan S, Yoksan S, Tangnaratchakit K, Chuansumrit A (2012) Alteration of cytokines and chemokines during febrile episodes associated with endothelial cell damage and plasma leakage in dengue hemorrhagic fever. *Pediatr Infect Dis J* 31:e232-238
- Caballero AA, Olmedo OA, Oddone VR (2009) Manifestaciones cutáneas del dengue. *Piel* 24:520-523 (In Spanish)
- Campagna DdS, Miagostovich MP, Siqueira MM, Cunha RVd (2006) Etiology of exanthema in children in a dengue endemic area. *Jornal de pediatria* 82:354-358
- Chadwick D, Arch B, Wilder-Smith A, Paton N (2006) Distinguishing dengue fever from other infections on the basis of simple clinical and laboratory features: application of logistic regression analysis. *J Clin Virol* 35:147-153

- Chaturvedi UC, Agarwal R, Elbishbishi EA, Mustafa AS (2000) Cytokine cascade in dengue hemorrhagic fever: implications for pathogenesis. *FEMS Immunol Med Microbiol* 28:183-188
- Chen CH, Huang YC, Kuo KC, Li CC (2017) Clinical features and dynamic ordinary laboratory tests differentiating dengue fever from other febrile illnesses in children. *J Microbiol Immunol Infect* 51:614-620.
- Chungue E, Burucoa C, Boutin J-P, Philippon G, Laudon F, Plichart R, Barbazan P, Cardines R, Roux J (1992) Dengue 1 epidemic in French Polynesia, 1988–1989: surveillance and clinical, epidemiological, virological and serological findings in 1752 documented clinical cases. *Trans R Soc Trop Med Hyg* 86:193-197.
- Conroy AL, Gélvez M, Hawkes M, Rajwans N, Tran V, Liles WC, Villar-Centeno LA, Kain KC (2015) Host biomarkers are associated with progression to dengue haemorrhagic fever: a nested case-control study. *Int J Infect Dis* 40:45-53
- Cordeiro MT, Schatzmayr HG, Nogueira RMR, Oliveira VFd, Melo WTd, Carvalho EFd (2007) Dengue and dengue hemorrhagic fever in the State of Pernambuco, 1995-2006. *Revista da Sociedade Brasileira de Medicina Tropical* 40:605-611
- Cunha RV, Schatzmayr HG, Miagostovich MP, Barbosa AM, Paiva FG, Miranda RM, Ramos CC, Coelho JC, Dos Santos F, Nogueira RM (1999) Dengue epidemic in the State of Rio Grande do Norte, Brazil, in 1997. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 93:247-249
- Daumas RP, Passos SR, Oliveira RV, Nogueira RM, Georg I, Marzochi KB, Brasil P (2013) Clinical and laboratory features that discriminate dengue from other febrile illnesses: a diagnostic accuracy study in Rio de Janeiro, Brazil. *BMC infectious diseases* 13:77
- Deen JL, Harris E, Wills B, Balmaseda A, Hammond SN, Rocha C, Dung NM, Hung NT, Hien TT, Farrar JJ (2006) The WHO dengue classification and case definitions: time for a reassessment. *Lancet* 368:170-173
- Deparis X, Murgue B, Roche C, Cassar O, Chungue E (1998) Changing clinical and biological manifestations of dengue during the dengue-2 epidemic in French Polynesia in 1996/97-description and analysis in a prospective study. *Trop Med Int Health* 3:859-65.
- Deshwal R, Qureshi MI, Singh R (2015) Clinical and laboratory profile of dengue fever. *JAPI* 63:30-32
- Desruelles F, Lamaury I, Roudier M, Goursaud R, Mahe A, Castanet J, Strobel M (1997) Cutaneo-mucous manifestations of dengue. *Ann Dermatol Venereol* 124:237-241. (In French)
- Ezeamuzie C, Al-Ali S, Al-Dowaisan A, Khan M, Hijazi Z, Thomson M (1999) Reference values of total serum IgE and their significance in the diagnosis of allergy among the young adult Kuwaiti population. *Clin Ex Allergy* 29:375-381
- Fahy JV (2015) Type 2 inflammation in asthma [mdash] present in most, absent in many. *Nat Rev Immunol* 15:57-65
- Ferreira GL (2012) Global dengue epidemiology trends. *Revista do Instituto de Medicina Tropical de São Paulo* 54:5-6
- Figueiredo MAA, Rodrigues LC, Barreto ML, Lima JWO, Costa MCN, Morato V, Blanton R, Vasconcelos PFC, Nunes MRT, Teixeira MG (2010) Allergies and Diabetes as Risk Factors for Dengue Hemorrhagic Fever: Results of a Case Control Study. *PLoS Negl Trop Dis* 4:e699
- Flipse J, Diosa-Toro MA, Hoornweg TE, Van De Pol DP, Urcuqui-Inchima S, Smit JM (2016) Antibody-dependent enhancement of dengue virus infection in primary human macrophages; balancing higher fusion against antiviral responses. *Sci Rep* 6:29201
- Fujimoto DE, Koifman S (2014) Clinical and laboratory characteristics of patients with dengue hemorrhagic fever manifestations and their transfusion profile. *Revista brasileira de hematologia e hemoterapia* 36:115-120

- Furuta T, Murao LA, Lan NT, Huy NT, Huong VT, Thuy TT, Tham VD, Nga CT, Ha TT, Ohmoto Y, Kikuchi M, Morita K, Yasunami M, Hirayama K, Watanabe N (2012) Association of mast cell-derived VEGF and proteases in Dengue shock syndrome. *PLoS Negl Trop Dis* 6:e1505
- Gómez Marrugo D, Causil Garcés C, Pinzón Redondo H, Suárez Causado A, Moneriz Pretell C (2014) Clinical characterization of dengue in a children's hospital of Cartagena (Colombia). *Revista Salud Uninorte* 30:281-292
- Gibbons RV, Vaughn DW (2002) Dengue: an escalating problem. *BMJ* 324:1563-1566
- González Cortiñas M, Vidal González D, Cepero Cordero J, Lashley Oliveras ML (1999) Dengue hemorrágico: Estudio clínico de 200 pacientes. *Revista cubana de medicina* 38:13-18
- Gonzalez-de-Olano D, Alvarez-Twose I (2018) Mast Cells as Key Players in Allergy and Inflammation. *J Investig Allergol Clin Immunol* 28:365-378
- Guha-Sapir D, Schimmer B (2005) Dengue fever: new paradigms for a changing epidemiology. *Emerg Themes Epidemiol* 2:1-1
- Gupta AK, Peshattiwar P, Romday R, Bhambani P (2016) A Study of Clinical and Laboratory Profile of Dengue Fever cases in a Tertiary Care Teaching Hospital. *Int J Curr Microbiol App Sci* 5:295-307
- Guzmán MG, Kouri G (1996) Advances in dengue diagnosis. *Clin Diagn Lab Immunol* 3:621-627
- Guzman MG, Kouri G, Soler M, Bravo J, Vega ARdl, Vazquez S, Mune M (1992) Dengue 2 virus enhancement in asthmatic and non asthmatic individual. *Memórias do Instituto Oswaldo Cruz* 87:559-564
- Health NIO (2014) Quality assessment tool for observational cohort and cross-sectional studies. National Heart, Lung, and Blood Institute. <http://www.nhlbi.nih.gov/health-pro/guidelines/indevelop/cardiovascular-risk-reduction/tools/cohort> Accessed November 5, 2015
- Higgins JPT, Thompson SG, Deeks JJ, Altman DG (2003) Measuring inconsistency in meta-analyses. *BMJ* 327:557-560
- Hochedez P, Canestri A, Guihot A, Bricler S, Bricaire F, Caumes E (2008) Management of travelers with fever and exanthema, notably dengue and chikungunya infections. *Am J Trop Med Hyg* 78:710-713
- Huedo-Medina TB, Sanchez-Meca J, Marin-Martinez F, Botella J (2006) Assessing heterogeneity in meta-analysis: Q statistic or I2 index? *Psychol Methods* 11:193-206
- Itoda I, Masuda G, Suganuma A, Imamura A, Ajisawa A, Yamada K, Yabe S, Takasaki T, Kurane I, Totsuka K, Negishi M (2006) Clinical features of 62 imported cases of dengue fever in Japan. *Am J Trop Med Hyg* 75:470-474.
- Kamath SR, Ranjit S (2006) Clinical features, complications and atypical manifestations of children with severe forms of dengue hemorrhagic fever in South India. *Indian J Pediatr* 73:889-895
- Kao JH, Chen CD, Tiger Li ZR, Chan TC, Tung TH, Chu YH, Cheng HY, Liu JW, Shih FY, Shu PY, Lin CC, Tsai WH, Ku CC, Ho CK, King CC (2016) The Critical Role of Early Dengue Surveillance and Limitations of Clinical Reporting—Implications for Non-Endemic Countries. *PloS One* 11:e0160230
- Kauser MM, Kalavathi G, Radadiya M, Karthik M, Afreen A, Kumaraswamy R (2014) A study of clinical and laboratory profile of Dengue fever in tertiary care hospital in central Karnataka, India. *Global J Med Res* 5.
- Khabiri A, Bagheri F, Assmar M, Siavashi M (2006) Analysis of specific IgE and IgG subclass antibodies for diagnosis of *Echinococcus granulosus*. *Parasite Immunol* 28:357-362
- Koraka P, Murgue B, Deparis X, Setiati TE, Suharti C, van Gorp E, Hack C, Osterhaus AD, Groen J (2003) Elevated levels of total and dengue virus - specific immunoglobulin E in patients with varying disease severity. *J Med Virol* 70:91-98

- Koraka P, Murgue B, DeParis X, Setiati TE, Suharti C, van Gorp EC, Hack CE, Osterhaus AD, Groen J (2003) Elevated levels of total and dengue virus-specific immunoglobulin E in patients with varying disease severity. *J Med Virol* 70:91-98
- Kurane I, Rothman AL, Livingston PG, Green S, Gagnon SJ, Janus J, Innis BL, Nimmannitya S, Nisalak A, Ennis FA (1994) Immunopathologic mechanisms of dengue hemorrhagic fever and dengue shock syndrome. *Arch Virol Suppl* 9:59-64
- Lessa Filho J (2008) Epidemiological study of Dengue infections in patients attended in a Public General Hospital, in Rio de Janeiro City, Brazil, during the outbreak of 2001-2002. *R Ci Md Biol* 7: 132-141
- Leung A, Heal C, Perera M, Pretorius C (2015) A systematic review of patient-related risk factors for catheter-related thrombosis. *J Thromb Thrombolysis* 40:363-373
- Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JPA, Clarke M, Devereaux PJ, Kleijnen J, Moher D (2009) The PRISMA Statement for Reporting Systematic Reviews and Meta-Analyses of Studies That Evaluate Health Care Interventions: Explanation and Elaboration. *PLoS Med* 6:e1000100
- Loroño Pino MA, Farfán Ale JA, Rosado Paredes EdP, Kuno G, Gubler DJ (1993) Epidemic dengue 4 in the Yucatan, Mexico, 1984. *Revista do Instituto de Medicina Tropical de São Paulo* 35:449-455
- Low JG, Ong A, Tan LK, Chatterji S, Chow A, Lim WY, Lee KW, Chua R, Chua CR, Tan SW (2011) The early clinical features of dengue in adults: challenges for early clinical diagnosis. *PLoS Negl Trop Dis* 5:e1191
- Míguez-Burbano MJ, Jaramillo CA, Palmer CJ, Shor-Posner G, Velásquez LS, Lai H, Baum MK (1999) Total immunoglobulin E levels and dengue infection on San Andres Island, Colombia. *Clin Diagn Lab Immunol* 6:624-626
- Mabalarajan U, Kadhiravan T, Sharma S, Banga A, Ghosh B (2005) Th2 immune response in patients with dengue during defervescence: preliminary evidence. *Am J Trop Med Hyg* 72:783-785
- Mahmood K, Jameel T, Aslam HF, Tahir M (2009) Incidence of dengue haemorrhagic fever in local population of Lahore, Pakistan. *Biomedica* 25:93-96
- Mahmood S, Hafeez S, Nabeel H, Zahra U, Nazeer H (2013) Does comorbidity increase the risk of dengue hemorrhagic fever and dengue shock syndrome? *Int Sch Res Notices*. doi: 10.1155/2013/139273.139273
- Mims JW (2015) Asthma: definitions and pathophysiology. In: *International forum of allergy & rhinolog.* vol S1. Wiley Online Library.
- Mukhtar F, Salim M, Farooq A (2012) Outbreak of dengue fever in Lahore: study of risk factors. *J Ayub Med Coll Abbottabad* 24:99-101
- Munafo MR, Flint J (2004) Meta-analysis of genetic association studies. *Trends Genet* 20:439-444
- Ndii MZ, Allingham D, Hickson R, Glass K (2016) The effect of Wolbachia on dengue outbreaks when dengue is repeatedly introduced. *Theor Popul Biol* 111:9-15
- Nogueira RM, Miagostovich MP, Schatzmayr HG, Moraes GC, Cardoso F, Ferreira J, Cerqueira V, Pereira M (1995) Dengue type 2 outbreak in the south of the state of Bahia, Brazil: laboratorial and epidemiological studies. *Revista do Instituto de Medicina Tropical de São Paulo* 37:507-510
- Organization WH, Research SPf, Diseases TiT, Diseases WHODOCoNT, Epidemic WHO, Alert P (2009) Dengue: guidelines for diagnosis, treatment, prevention and control. World Health Organization.
- Orozco Hechavarría N, Díaz Portuondo IM, Abad Cañete U, Martínez Delgado Y (2001) Incidencia de dengue en niños y adolescentes. *Revista cubana de medicina tropical* 53:16-19

- Palomeque WA, Briones MC, Lam RM, Briones CT (2004) Formas de presentación de dengue clásico en lactantes preescolares y escolares: hospital León Becerra 2001. *Revista Medicina* 9:299-303
- Pang J, Salim A, Lee VJ, Hibberd ML, Chia KS, Leo YS, Lye DC (2012) Diabetes with hypertension as risk factors for adult dengue hemorrhagic fever in a predominantly dengue serotype 2 epidemic: a case control study. *PLoS Negl Trop Dis* 6:e1641
- Pang X, Zhang R, Cheng G (2017) Progress towards understanding the pathogenesis of dengue hemorrhagic fever. *Virologica Sinica* 32:16-22
- Passos S, Bedoya S, Hökerberg Y, Maia S, Georg I, Nogueira R, Souza R, Marzochi K (2008) Clinical and laboratory signs as dengue markers during an outbreak in Rio de Janeiro. *Infection* 36:570
- Pavri K, Sheikh B, Ghosh S, Chodankar V (1977) Immunoglobulin E in sera of patients of dengue haemorrhagic fever. *Indian Med Res* 66:537-543
- Pavri K, Swe T, Ramamoorthy C, Chodankar V (1979) Immunoglobulin E in dengue haemorrhagic fever (DHF) cases. *Trans R Soc Trop Med Hyg* 73:451-452
- Potenzieri C, Udem BJ (2012) Basic mechanisms of itch. *Clin Exp Allergy* 42:8-19
- Raman MH, Alam AYMS, Rahman AM, Khan MS, Shapla NR, Aleem MA (2013) Presentation, Management and Outcome of Dengue Fever—A Study of 200 Cases. *J Med* 14:18-22
- Renke J, Kędzierska-Mieszkowska S, Lange M, Nedoszytko B, Wasilewska E, Liberek A, Renke M, Nedoszytko M, Witkowski J, Skórko-Glonek J, Lipińska B (2019) Mast cells in mastocytosis and allergy – Important player in metabolic and immunological homeostasis. *Adv Med Sci* 64:124-130
- Rigau-Perez JG (2006) Severe dengue: the need for new case definitions. *Lancet Infect Dis* 6:297-302
- Rubio DG, Peraza OC, Delgado FR, Ramírez DP, Martínez MG, Rodríguez AM, Bada NR, Guzmán Tirado MG (2008) Description of dengue hemorrhagic fever, serotype 3, City of Havana, 2001-2002. *Revista Cubana de Medicina Tropical* 60
- Rush B (1951) An account of the bilious remitting fever: As it appeared in Philadelphia, in the summer and autumn of the year 1780. *The American Journal of Medicine* 11:546-550
- Saleem K, Shaikh I (2008) Skin lesions in hospitalized cases of dengue Fever. *J Coll Physicians Surg Pak* 18:608-611
- Sanchez LF, Hotta H, Hotta S, Homma M (1986) Degranulation and histamine release from murine mast cells sensitized with dengue virus-immune sera. *Microbiol Immunol* 30:753-759
- Schmidt AC, Lin L, Martinez LJ, Ruck RC, Eckels KH, Collard A, De La Barrera R, Paolino KM, Toussaint J-F, Lepine E (2017) Phase 1 Randomized Study of a Tetravalent Dengue Purified Inactivated Vaccine in Healthy Adults in the United States. *Am J Trop Med Hyg* 96:1325-1337
- Sheikh KR, Shehzad A, Mufti S, Mirza UA (2012) Skin involvement in patients of dengue fever during the 2011 epidemic in Lahore, Pakistan. *Journal of Pakistan Association of Dermatologists* 22:325-330
- Simmons CP, Farrar JJ (2012) Current Concepts. *N Engl J Med* 366:1423-1432
- Syenina A, Jagaraj CJ, Aman SA, Sridharan A, St John AL (2015) Dengue vascular leakage is augmented by mast cell degranulation mediated by immunoglobulin Fcγ receptors. *Elife* 4
- Teixeira MG, Paixão ES, Maria da Conceição NC, Cunha RV, Pamplona L, Dias JP, Figueiredo CA, Figueiredo MAA, Blanton R, Morato V (2015) Arterial hypertension and skin allergy are risk factors for progression from dengue to dengue hemorrhagic fever: a case control study. *PLoS Negl Trop Dis* 9:e0003812
- Tewari K, Tuli N, Devgun S (2013) Clinical profile of dengue fever and use of platelets in four tertiary level hospitals of Delhi in the year 2009. *Headache* 63:27-39

- Thangaratham P, Rajendran R, Paramasivan R, Tewari S, Dhananjeyan K, Tyagi B (2013) Clinical spectrum during dengue haemorrhagic fever epidemics in Tirupur (India). *J Vector Borne Dis* 50:311
- Thomas EA, John M, Bhatia A (2007) Cutaneous manifestations of dengue viral infection in Punjab (north India). *Int J Dermatol* 46:715-719
- Tristão-Sá R, Kubelka CF, Zandonade E, Zagne SMO, Rocha NdSM, Zagne LO, Araújo NF, Amin B, Fazoli F, Souza LJd (2012) Clinical and hepatic evaluation in adult dengue patients: a prospective two-month cohort study. *Revista da Sociedade Brasileira de Medicina Tropical* 45:675-681
- Tuchinda M, Dhorraintra B, Tuchinda P (1977) Histamine content in 24-hour urine in patients with dengue haemorrhagic fever. *Southeast Asian J Trop Med Public Health* 8:80-83
- Vasconcelos P, Lima J, Da Rosa A, Timbo M, da Rosa E, Lima H, Rodrigues S, da Rosa J (1998) Dengue epidemic in Fortaleza, Ceara: randomized seroepidemiologic survey. *Revista de saude publica* 32:447-454
- Vazquez S, Lozano C, Perez AB, Castellanos Y, Ruiz D, Calzada N, Guzmán MG (2014) Dengue specific immunoglobulins M, A, and E in primary and secondary dengue 4 infected Salvadorian children. *J Med Virol* 86:1576-1583
- Vazquez S, Perez A, Ruiz D, Rodriguez R, Pupo M, Calzada N, González L, González D, Castro O, Serrano T (2005) Serological markers during dengue 3 primary and secondary infections. *J Clin Virol* 33:132-137
- Wali J, Biswas A, Handa R, Aggarwal P, Wig N, Dwivedi S (1999) Dengue haemorrhagic fever in adults: a prospective study of 110 cases. *Tropical Doctor* 29:27-30
- Wieten RW, Vlietstra W, Goorhuis A, van Vugt M, Hodiament CJ, Leenstra T, de Vries PJ, Janssen S, van Thiel PP, Stijns K (2012) Dengue in travellers: applicability of the 1975–1997 and the 2009 WHO classification system of dengue fever. *Trop Med Int Health* 17:1023-1030
- Yaqoob P, Calder PC (1998) Cytokine production by human peripheral blood mononuclear cells: differential sensitivity to glutamine availability. *Cytokine* 10:790-794