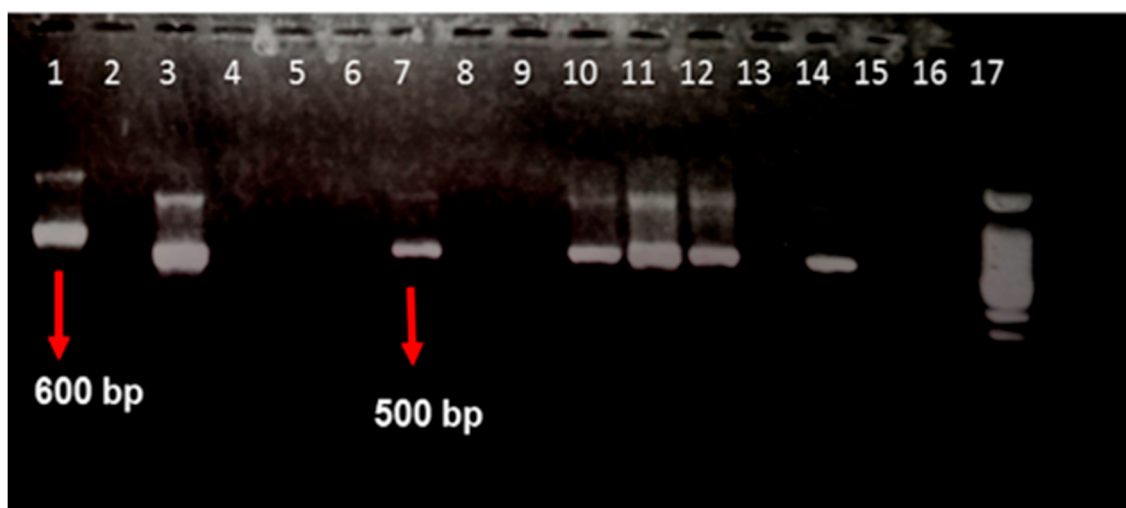


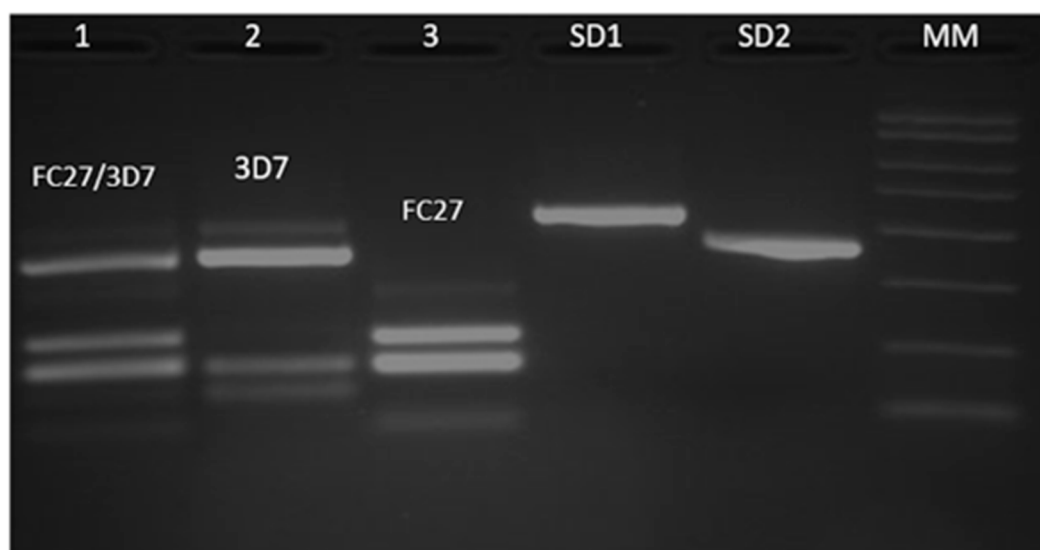
Supplementary Materials

***Plasmodium falciparum* Genetic Diversity in Panamá Based on *glurp*, *msh-1* and *msh-2* genes: Implications for Malaria Elimination in Mesoamerica**

(A)



(B)



(C)

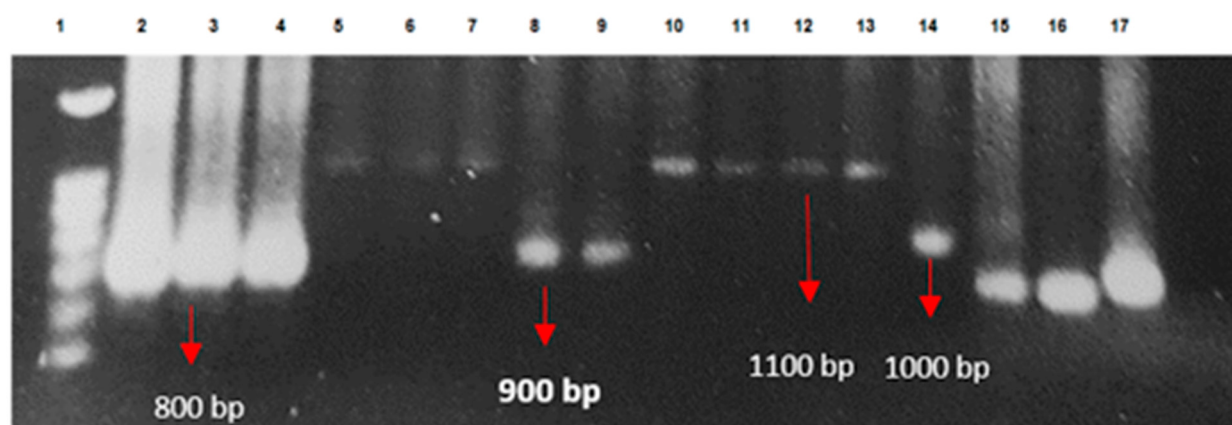


Figure S1. Genotyping of *Plasmodium falciparum* infections by PCR amplification of: (a). Merozoite surface proteins 1 (msp-1), (b) Merozoite surface proteins 2 (msp-2) and (c) Glutamate rich protein (glurp).

(a) Representative agarose gel for *P. falciparum* msp-1 gene nested PCR products. Lane 1: 600 bp genotype. Lanes 3, 7, 10, 11, 12 and 14: 500 bp genotype; Lanes 2, 4, 5, 6, 8, 9, 13, 15 and 16: no amplification; Lane 17: Molecular weight marker (100-bp ladder).

(b) Representative agarose gel for *P. falciparum* msp-2 gene products digested with Hinf I. Lane 1: 3D7/FC27 mixed infection; Lane 2: Allelic family 3D7; Lane 3: Allelic Family FC27; SD1 and SD2: Undigested PCR product; MM: Molecular weight marker (100-bp ladder).

(c) Representative agarose gel for *P. falciparum* glurp gene nested PCR products. Lane 1: Molecular weight marker (100-bp ladder); Lanes 2, 3, 4, 15, 16, and 17: 800 bp genotype; Lanes 5, 6, 7, 10, 11, 12 and 13: 1100 bp genotype; Lanes 8 and 9: 900 bp genotype; Lane 14: 1000 bp genotype.

Table S1. Prevalence of genotypes (*msp-1*, *msp-2* and *glurp* alleles) by origin of the infection in patients from Panamá. Alleles of *glurp* and *msp-1* were classified by fragment length of the nested PCR products. Allelic families of *msp-2* were identified by PCR-RFLP (Hinf I).

Isolates Origin	<i>glurp</i> Genotype I	<i>glurp</i> Genotype II	<i>glurp</i> Genotype III	<i>glurp</i> Genotype IV	<i>msp-1</i> Genotype I	<i>msp-1</i> Genotype II	<i>msp-2</i> (3D7)	<i>msp-2</i> (FC27)	<i>msp-2</i> (3D7/FC27)
Panamá Este	1 (1.2%)	0	0	18 (22.2%)	19 (23.2%)	0	18 (17.8%)	0	1 (1.0%)
Guna Yala	28 (34.6%)	2 (2.5%)	0	1 (1.2%)	31 (37.8%)	0	50 (49.5%)	1 (1.0%)	1 (1.0%)
Darién	6 (7.4%)	0	0	2 (2.5%)	8 (9.8%)	0	5 (5.0%)	2 (2.0%)	0
Imported*	5 (6.2%)	2 (2.5%)	8 (9.8%)	8 (9.8%)	19 (23.2%)	5 (6.1%)	15 (14.8%)	7 (6.9%)	1 (1.0%)
TOTAL	40	4	8	29	77	5	88	10	3
	81			82			101		

* Imported status was inferred by the epidemiological data provided National Malaria Programme based on the travel history declared by the patients.

Table S2. Haplotypes diversity and distribution inferred by combining the alleles detected in the three loci (*glurp*, *msp-2* and *msp-1*) in *Plasmodium falciparum* indigenous and imported cases based on patients' travel history.

	<i>glurp</i>	<i>msp-2</i>	<i>msp-1</i>	Darién	Guna Yala	Panamá Este	Imported	Total
Haplotype 1	1100 bp	3D7	500 bp	2		17	3	22
Haplotype 2	1100 bp	3D7/FC27	500 bp			1	1	2
Haplotype 3	800 bp	3D7	500 bp	3	26	1	5	35
Haplotype 4	1100 bp	FC27	500 pb				2	2
Haplotype 5	1000 bp	FC27	500 pb				2	2
Haplotype 6	900 bp	FC27	500 pb				2	2
Haplotype 7	1000 bp	3D7	500pb				3	3
Haplotype 8	1100 bp	3D7	600 pb				1	1
Haplotype 9	800 bp	3D7/FC27	500 bp		1			1
Haplotype 10	800 bp	FC27	500 bp	2	2			4
Haplotype 11	1000 bp	3D7	600 pb				3	3
Haplotype 12	1100 bp	FC27	600 pb				1	1
				7	29	19	23	78

Table S3. Epidemiological data and genotyping results from samples analyzed in this study.

Number	glurp	msp-1	msp-2	H	A	Age	Sex	Locality	Province	CY	S	PL	GP	Origin
PB01	G4	G1	G2	1	Adult	42	F	Puente Bayano	PE	2004	Rainy	High	no	Local
PB02	G4	G1	G2	1	Infant	12	F	Puente Bayano	PE	2004	Rainy	Medium	yes	Local
PB03	G4	G1	G2	1	Adult	23	F	Puente Bayano	PE	2004	Rainy	Low	yes	Local
PB04	G4	G1	G2	1	Infant	7	F	Puente Bayano	PE	2004	Rainy	High	no	Local
PB05	G4	G1	G2	1	Infant	15	F	Puente Bayano	PE	2004	Rainy	High	no	Local
PB06	G4	G1	G2	1	Infant	9	F	Puente Bayano	PE	2004	Rainy	Low	yes	Local
PB07	G4	G1	G2	1	Adult	69	F	Puente Bayano	PE	2004	Dry	High	no	Local
PB08	G4	G1	G2	1	Adult	36	F	Puente Bayano	PE	2004	Rainy	High	no	Local
PB09	G4	G1	G2	1	Infant	7	M	Puente Bayano	PE	2004	Rainy	High	no	Local
PB10	G4	G1	G2	1	Child	2	F	Puente Bayano	PE	2004	Rainy	High	yes	Local
PB11	G4	G1	G2	1	Infant	7	F	Puente Bayano	PE	2011	Rainy	High	no	Local
PB12	G4	G1	G2	1	Child	3	F	Puente Bayano	PE	2004	Rainy	High	no	Local
PB13	G4	G1	G2	1	Child	4	M	Puente Bayano	PE	2004	Rainy	High	no	Local
PB14	G4	G1	G2	1	Adult	51	M	Puente Bayano	PE	2004	Rainy	High	no	Local
PB15	G4	G1	G2	1	Child	5	F	Puente Bayano	PE	2004	Rainy	High	no	Local
PE01	G4	G1	G2	1	Adult	36	F	Naragandi	PE	2007	Dry	High	yes	Local
PM01	G4	G1	G2	1	Adult	18	F	Río Sabalo	PE	2007	Dry	High	no	Local
PF01	G4	G1	G3	2	Adult	21	F	Aguas Claras, Puente Bayano	PE	2004	Rainy	High	no	Local
PF02	G1	G1	G1	10	Adult	34	M	Ticanti Nargana	GY	2003	Rainy	NA	no	Local
PF03	G1	G1	G2	3	Child	4	M	Aguas Claras, Puente Bayano	PE	2004	Dry	High	no	Local
PF04	G1	G1	G1	10	Adult	35	F	Jaque	DA	2003	Rainy	NA	no	Local
DA02	G4	G1	G2	1	Adult	41	F	Camino Real	DA	2007	Rainy	Low	yes	Local
DA03	G1	G1	G2	3	Infant	8	M	Puerto Piña	DA	2007	Rainy	High	yes	Local
DA04	G1	G1	G2	3	Adult	43	M	Puerto Piña	DA	2007	Rainy	High	yes	Local
DA29	G1	G1	G2	3	Adult	41	F	Jaque	DA	2007	Rainy	Low	yes	Local
DA55	G4	G1	G2	1	Adult	42	M	Cocalito	DA	2016	Rainy	Low	no	Local
DA70	G1	G1	NA	NA	Adult	21	M	Puerto Piña	DA	2019	Rainy	High	yes	Local
DA72	G1	G1	G1	10	Adult	37	F	Puerto Piña	DA	2019	Rainy	High	yes	Local
PO04	G1	G1	G2	3	Adult	19	M	Africa, Tanzania	Imported	2008	Dry	High	no	Imported
PO08	G4	G1	G1	4	Adult	50	M	Haiti	Imported	2009	Rainy	NA	no	Imported
PO09	G3	G1	G1	5	Adult	41	M	Philippines	Imported	2010	Rainy	NA	no	Imported
PO11	G2	G1	G1	6	Adult	18	F	China	Imported	2007	Dry	High	no	Imported

P013	G3	G1	G2	7	Adult	21	M	Africa (Equatorial Guinea)	Imported	2013	Rainy	High	no	Imported
P014	G1	G1	G2	3	Infant	14	M	Africa (Tanzania, Kenya, South Africa)	Imported	2013	Rainy	High	no	Imported
P015	G2	G1	G1	6	Adult	69	M	Africa (Mozambique) Philippines	Imported	2013	Rainy	High	yes	Imported
P016	G3	G1	G1	5	Adult	25	M	India	Imported	2014	Rainy	High	no	Imported
P017	G3	G1	G2	7	Adult	23	M	Africa, Nigeria	Imported	2014	Rainy	High	no	Imported
P018	G4	G2	G2	8	Adult	59	F	West Africa	Imported	2014	Rainy	High	no	Imported
P019	G1	G1	G2	3	Adult	34	M	Egypt	Imported	2015	Dry	High	yes	Imported
P020	G3	G2	G2	11	Adult	29	M	India, Bombay	Imported	2015	Rainy	NA	no	Imported
P023	G1	G1	G2	3	Adult	25	F	Guyana, Venezuela, Colombia	Imported	2015	Rainy	High	yes	Imported
P041	G4	G1	G1	4	Adult	36	M	Africa (Zimbabwe, Malawi)	Imported	2017	Dry	NA	no	Imported
P046	G1	G1	G2	3	Adult	36	M	Africa (Zimbabwe, Malawi)	Imported	2017	Dry	NA	no	Imported
P047	NA	G1	NA	NA	Adult	36	M	Africa (Zimbabwe, Malawi)	Imported	2017	Dry	NA	no	Imported
P051	G4	G1	G2	1	Adult	53	M	Africa	Imported	2017	Rainy	High	no	Imported
P052	G4	G1	G3	2	Adult	54	M	Central Africa (Louma)	Imported	2017	Rainy	High	yes	Imported
P053	G4	G1	G2	1	Adult	44	M	Africa (Burkina Faso)	Imported	2017	Rainy	NA	no	Imported
P055	G4	G1	G2	1	Adult	41	M	Africa, Saudi Arabia	Imported	2018	Dry	NA	no	Imported
P057	G3	G2	G2	11	Adult	23	M	Africa (Cameroon)	Imported	2019	Rainy	High	no	Imported
P058	G3	G2	G2	11	Adult	22	M	Africa, Cameroon)	Imported	2019	Dry	High	no	Imported
P060	G4	G2	G1	12	Adult	33	M	Africa (Cameroon)	Imported	2019	Dry	High	no	Imported
P061	G3	G1	G2	7	Adult	38	M	Colombia	Imported	2019	Rainy	High	no	Imported
KY-001	NA	NA	G2	NA	Adult	40	F	Carreto	GY	2004	Dry	High	no	Local
KY-002	NA	NA	G2	NA	Infant	6	M	Carreto	GY	2004	Dry	High	no	Local
KY-003	NA	NA	G2	NA	Adult	39	F	Carreto	GY	2004	Dry	High	no	Local
KY-004	G1	G1	G2	3	Adult	36	M	Carreto	GY	2004	Dry	High	no	Local
KY-007	NA	NA	G2	NA	Adult	19	F	Carreto	GY	2004	Dry	High	no	Local
KY-008	G1	G1	G2	3	Infant	11	M	Carreto	GY	2004	Dry	High	no	Local
KY-010	NA	NA	G2	NA	Infant	15	M	Carreto	GY	2004	Dry	High	yes	Local

KY-011	NA	NA	G2	NA	Child	5	F	Sasardi Mulatupo	GY	2004	Dry	High	no	Local
KY-016	G1	G1	G2	3	Adult	53	M	Carreto	GY	2004	Dry	High	no	Local
KY-017	G1	G1	G2	3	Infant	13	M	Carreto	GY	2004	Dry	High	no	Local
KY-018	G1	G1	G2	3	Adult	34	F	Carreto	GY	2004	Dry	High	no	Local
KY-022	NA	NA	G2	NA	Adult	23	F	Sasardi Mulatupo	GY	2004	Dry	High	no	Local
KY-025	NA	NA	G2	NA	Adult	26	F	Carreto	GY	2004	Dry	High	yes	Local
KY-030	NA	NA	G2	NA	Infant	14	M	Ogosucur	GY	2004	Dry	NA	no	Local
KY-031	NA	NA	G2	NA	Adult	25	F	Carreto	GY	2004	Dry	Medium	yes	Local
KY-032	G1	G1	G2	3	Adult	28	M	Carreto	GY	2004	Dry	Medium	no	Local
KY-037	G1	G1	G2	3	Adult	47	M	Sasardi Muluatupo	GY	2004	Dry	High	no	Local
KY-038	NA	NA	G2	NA	Adult	40	M	Sasardi Muluatupo	GY	2004	Dry	High	no	Local
KY-042	NA	NA	G2	NA	Adult	33	M	Playon Chico	GY	2004	Dry	High	no	Local
KY-044	G2	G1	NA	NA	Child	4	F	Irgandi	GY	2004	Rainy	High	no	Local
KY-049	NA	NA	G2	NA	Adult	32	M	Ustupo	GY	2004	Dry	NA	no	Local
KY-053	NA	NA	G2	NA	Adult	27	F	Carreto	GY	2004	Dry	High	yes	Local
KY-056	G1	G1	G2	3	Adult	33	F	Irgandi	GY	2004	Dry	Medium	no	Local
KY-057	G1	G1	G3	9	Adult	31	M	Playon Grande	GY	2004	Dry	NA	no	Local
KY-063	NA	NA	G2	NA	Adult	32	M	Playon Grande	GY	2004	Dry	High	no	Local
KY-065	G1	G1	G2	3	Adult	28	M	Muluatupo	GY	2004	Dry	High	no	Local
KY-066	G1	G1	G2	3	Adult	78	M	Muluatupo	GY	2004	Dry	High	yes	Local
KY-069	G1	G1	G2	3	Adult	18	F	Navagandi	GY	2004	Dry	High	no	Local
KY-070	G1	G1	G2	3	Adult	35	M	Sasard muluatupo	GY	2004	Dry	High	no	Local
KY-073	NA	NA	G2	10	Adult	30	F	Ogobsucum	GY	2004	Dry	NA	no	Local
KY-075	NA	NA	G2	NA	Adult	49	F	Ustupo	GY	2004	Dry	High	no	Local
KY-076	G1	G1	G2	3	Adult	30	F	Ogobsucum	GY	2004	Dry	NA	no	Local
KY-079	G1	G1	G2	3	Child	4	M	Navagandi	GY	2004	Dry	NA	no	Local
KY-082	NA	NA	G2	NA	Adult	56	M	Isla Cuba	GY	2004	Dry	NA	no	Local
KY-085	NA	NA	G2	NA	Infant	15	F	Navagandi	GY	2004	Dry	High	yes	Local
KY-086	G1	G1	G2	3	Infant	9	F	Navagandi	GY	2004	Dry	High	no	Local
KY-087	G1	G1	G2	3	Adult	28	F	Navagandi	GY	2004	Dry	High	no	Local
KY-088	G1	G1	G2	3	Adult	35	M	Navagandi	GY	2004	Dry	Medium	yes	Local
KY-089	G1	G1	G2	3	Adult	35	F	Navagandi	GY	2004	Dry	High	yes	Local
KY-092	G1	G1	G2	3	Adult	41	M	La miel	GY	2004	Dry	NA	no	Local
KY-093	NA	NA	G2	NA	Child	4	M	La miel	GY	2004	Dry	NA	no	Local
KY-094	NA	NA	G2	NA	Infant	8	F	Armila	GY	2004	Dry	NA	no	Local
KY-095	NA	NA	G2	NA	Infant	8	M	Armila	GY	2004	Rainy	NA	no	Local
KY-096	NA	NA	G2	NA	Infant	9	M	Armila	GY	2004	Dry	NA	no	Local
KY-097	G1	G1	G2	3	Adult	46	F	Navagandi	GY	2004	Dry	High	yes	Local

KY-098	G1	G1	G2	3	Adult	26	M	Sasardi	GY	2004	Rainy	High	yes	Local
KY-105	G1	G1	G2	3	Infant	15	F	Nueva Anachucuna	GY	2004	Rainy	High	yes	Local
KY-107	G1	G1	G2	3	Adult	20	F	Carreto	GY	2004	Dry	High	no	Local
KY-108	G1	G1	G2	3	Adult	37	M	Cuba	GY	2004	Dry	High	no	Local
KY-114	G1	G1	G2	3	Adult	38	F	Isla Pino	GY	2004	Dry	Low	no	Local
KY-128	NA	NA	G2	NA	Infant	14	M	Manduyala	GY	2004	Dry	NA	no	Local
KY-129	G1	G1	G2	3	Adult	19	M	Nargana	GY	2004	Rainy	Low	no	Local
KY-148	G4	G1	NA	NA	Adult	39	M	Puerto Obaldia	GY	2014	Rainy	Low	no	Local
KY-152	G2	G1	NA	NA	Adult	51	M	Nargana	GY	2015	Rainy	NA	no	Local

G [Genotype] (1 to 3 and NA for not analyzed); H [Haplotype] (1 to 12 and NA for not analyzed); A [Age] (Child, Infant, Adult); Sex (M: Male, F: Female); Province (D: Darien, PE: Panamá Este, GY: Guna Yala, Imported); CY [Collection Year]; S [Season] (Rainy, Dry); PL [Parasite Load] (High, Medium, Low and NA for not analyzed); GP[Gametocyte Presence] (Yes or No); [Origin] (Local or imported based on patients' travel history).

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