Indicators of improved water access in the context of schistosomiasis transmission in rural Eastern Region, Ghana

Alexandra V. Kulinkina [a] *, Karen C. Kosinski [b], Jeanine D. Plummer [c], John L. Durant [a], Kwabena M. Bosompem [d, e], Michael N. Adjei [f], Jeffrey K. Griffiths [g], David M. Gute [a], Elena N. Naumova [a, g, h]

[a] Department of Civil and Environmental Engineering, Tufts University, 200 College Avenue, Medford, USA
* Corresponding author; Email: alexandra.kulinkina@tufts.edu

[b] Department of Community Health, Tufts University, 574 Boston Avenue, Medford, USA

[c] Water Quality & Treatment Solutions, Inc., 175A Rice Corner Road, Brookfield, USA

[d] Noguchi Memorial Institute for Medical Research, University of Ghana, P. O. Box 25, Legon, Accra, Ghana

[e] Community Directed Development Foundation, P. O. Box AT2374, Achimota, Accra, Ghana

[f] Unaffiliated, P.O. Box 399, Teshie, Accra, Ghana

[g] Tufts University School of Medicine, 136 Harrison Avenue, Boston, USA

[h] Friedman School of Nutrition Science and Policy, Tufts University, 150 Harrison Avenue, Boston, USA

Table S1: Comparison of indicator values by district and by population category.

Table S2: Spearman's rank correlations between improved water and surface water access indicators.

Table S1: Comparison of indicator values by district and by population category.

Indicator	Overall	AKY	ATW	BRC	BRS	KBR	SKC	WAK	500 – 999	1000 – 1999	2000 – 4999	5000 – 9999
n	74	4	12	5	5	13	15	20	13	29	27	5
I_{iws}	63 (57, 69)	47 (20, 74)	**82 (71, 93)**	57 (28, 87)	59 (44, 74)	67 (50, 84)	63 (49, 77)	54 (43, 65)	72 (54, 90)	63 (54, 71)	56 (47, 64)	81 (52, 100)
I_{fiws}	49 (43, 55)	43 (24, 61)	**66 (52, 81)**	46 (16, 77)	43 (19, 67)	55 (40, 70)	52 (35, 68)	37 (25, 50)	58 (40, 75)	46 (35, 56)	45 (36, 54)	70 (48, 92)
Δ	14 ***	5	16 *	11	16 *	13 *	11 *	17 ***	14	17 ***	11 ***	11
$I_{iws(100)}$	22 (19, 24)	15 (3, 27)	22 (16, 28)	18 (3, 33)	**16 (14, 18)**	26 (17, 36)	22 (15, 29)	22 (16, 28)	26 (14, 39)	20 (17, 23)	19 (16, 23)	31 (13, 49)
$I_{fiws(100)}$	18 (15, 20)	13 (2, 24)	18 (12, 25)	16 (-1, 33)	**13 (8, 17)**	21 (16, 26)	19 (12, 26)	17 (10, 24)	22 (12, 31)	16 (12, 20)	16 (13, 19)	27 (9, 45)
Δ	4 ***	2	4 **	2	3	5	3 *	5 **	4	4 ***	3 ***	4
$I_{iws(200)}$	57 (52, 61)	37 (5, 68)	57 (48, 67)	54 (24, 84)	49 (38, 59)	67 (57, 78)	58 (45, 71)	55 (45, 65)	61 (43, 79)	55 (50, 61)	54 (47, 61)	67 (34, 100)
$I_{fiws(200)}$	48 (43, 54)	32 (5, 59)	49 (37, 61)	49 (11, 87)	39 (26, 53)	**60 (50, 71)**	51 (35, 66)	44 (31, 58)	55 (38, 72)	45 (35, 55)	47 (39, 55)	62 (27, 96)
Δ	8 ***	4	9 **	5	9	7 *	7	11 *	6	11 **	7 ***	5
$I_{iws(300)}$	79 (75, 84)	54 (10, 98)	81 (73, 89)	77 (49, 100)	76 (67, 84)	**90 (83, 97)**	79 (65, 94)	77 (69, 86)	79 (62, 96)	80 (74, 85)	78 (71, 86)	83 (49, 100)
$I_{fiws(300)}$	70 (63, 76)	49 (9, 89)	72 (61, 83)	71 (30, 100)	64 (45, 83)	**84 (73, 95)**	71 (53, 90)	63 (47, 79)	75 (58, 93)	65 (53, 77)	71 (62, 79)	79 (40, 100)
Δ	9 ***	5	8 **	7	11	6	8	14 *	3	15 **	8 **	4
$I_{iws(400)}$	90 (86, 94)	65 (26, 100)	92 (88, 97)	89 (72, 100)	92 (87, 98)	**97 (92, 100)**	89 (75, 100)	89 (83, 95)	88 (71, 100)	92 (88, 95)	89 (83, 95)	89 (59, 100)
$I_{fiws(400)}$	81 (75, 87)	62 (22, 100)	87 (80, 95)	82 (48, 100)	83 (63, 100)	**92 (83, 100)**	81 (62, 100)	74 (57, 90)	86 (70, 100)	76 (63, 89)	83 (76, 91)	86 (52, 100)
Δ	9 ***	3	5 *	7	10	5	7	15	1	16 *	6 **	3
$I_{iws(500)}$	95 (91, 98)	76 (48, 100)	97 (95, 100)	96 (89, 100)	**99 (97, 100)**	**99 (97, 100)**	92 (78, 100)	95 (90, 99)	91 (75, 100)	97 (94, 99)	94 (91, 98)	92 (70, 100)
$I_{fiws(500)}$	87 (81, 93)	74 (41, 100)	**95 (90, 99)**	88 (63, 100)	91 (74, 107)	95 (89, 101)	86 (66, 100)	79 (62, 96)	91 (74, 100)	82 (69, 95)	90 (85, 95)	90 (63, 100)
Δ	8 **	2	3	8	8	4	6	15	0	15 *	4 *	2
$I_{iws(1000)}$	99 (96, 100)	100 (98, 100)	100 (--, --)	100 (--, --)	100 (--, --)	100 (--, --)	93 (79, 100)	100 (--, --)	92 (76, 100)	100 (--, --)	100 (100, 100)	100 (--, --)
$I_{fiws(1000)}$	93 (87, 99)	**100 (98, 100)**	**100 (--, --)**	**100 (--, --)**	100 (98, 100)	**100 (--, --)**	87 (67, 100)	85 (68, 100)	92 (76, 100)	86 (73, 100)	**100 (100, 100)**	**100 (--, --)**
Δ	5 *	0	0	0	0	0	7	15	0	14 *	0	0
$I_{psws(100)}$	7 (5, 8)	**1 (0, 3)**	**4 (2, 6)**	**1 (0, 4)**	**2 (0, 4)**	**3 (2, 5)**	10 (5, 16)	**11 (8, 14)**	7 (1, 13)	10 (7, 13)	**4 (2, 5)**	4 (0, 9)
$I_{psws(200)}$	21 (16, 26)	**5 (0, 11)**	14 (7, 20)	**6 (0, 21)**	**7 (0, 18)**	14 (8, 20)	29 (13, 46)	**34 (27, 41)**	26 (8, 44)	28 (20, 35)	**13 (9, 17)**	13 (0, 29)
$I_{psws(300)}$	37 (30, 43)	**14 (1, 27)**	28 (15, 40)	15 (0, 41)	17 (0, 41)	29 (17, 40)	44 (22, 65)	**57 (46, 67)**	43 (18, 67)	46 (36, 57)	**26 (18, 33)**	26 (0, 56)
$I_{psws(400)}$	51 (43, 59)	28 (1, 54)	43 (25, 61)	27 (0, 66)	30 (0, 70)	45 (29, 62)	54 (29, 78)	**74 (62, 85)**	55 (28, 82)	62 (49, 74)	40 (30, 51)	39 (0, 81)
$I_{psws(500)}$	62 (54, 71)	43 (0, 86)	56 (35, 77)	40 (0, 90)	43 (0, 92)	59 (41, 77)	59 (33, 85)	**85 (75, 94)**	62 (34, 90)	72 (60, 84)	54 (42, 67)	48 (1, 95)
$I_{psws(1000)}$	85 (77, 92)	92 (82, 100)	80 (56, 100)	67 (16, 100)	74 (21, 100)	91 (74, 100)	69 (45, 94)	**100 (--, --)**	74 (48, 100)	92 (82, 100)	84 (71, 96)	76 (23, 100)

Significant differences between IWS and FIWS with p-values <0.001 are denoted by ***, <0.01 by **, and <0.05 by *. Population category specific averages that are significantly different from the overall average (p<0.05) are bolded.

Table S2: Spearman's rank correlations between improved water and surface water access indicators.

	I_{iws}	I_{fiws}	$I_{iws(100)}$	$I_{fiws(100)}$	$I_{iws(200)}$	$I_{fiws(200)}$	$I_{iws(300)}$	$I_{fiws(300)}$	$I_{iws(400)}$	$I_{fiws(400)}$	$I_{iws(500)}$	$I_{fiws(500)}$	$I_{iws(1000)}$	$I_{fiws(1000)}$
FULL DATASET														
$I_{psws(100)}$	-0.18	-0.20	0.10	0.08	0.06	0.04	0.01	-0.12	0.01	0.02	0.02	0.00	-0.06	-0.22
$I_{psws(200)}$	-0.18	**-0.24**	0.11	0.09	0.09	0.08	0.05	-0.10	0.02	0.04	0.05	0.06	-0.01	-0.20
$I_{psws(300)}$	-0.18	**-0.24**	0.14	0.13	0.14	0.12	0.08	-0.10	0.06	0.08	0.10	0.10	0.04	-0.18
$I_{psws(400)}$	-0.19	**-0.26**	0.15	0.14	0.16	0.14	0.11	-0.08	0.09	0.11	0.13	0.14	0.09	-0.15
$I_{psws(500)}$	-0.20	**-0.28**	0.16	0.16	0.18	0.16	0.13	-0.05	0.10	0.13	0.16	0.17	0.12	-0.12
$I_{psws(1000)}$	-0.11	-0.20	0.13	0.11	0.12	0.14	0.13	0.04	0.09	0.11	0.14	0.18	0.14	-0.04
NO REGULAR PROACTIVE PAYMENT														
$I_{psws(100)}$	**-0.39**	**-0.39**	-0.10	-0.12	-0.11	-0.12	-0.14	-0.29	-0.18	-0.19	-0.20	-0.23	-0.28	-0.26
$I_{psws(200)}$	**-0.38**	**-0.43**	-0.07	-0.06	-0.06	-0.07	-0.10	-0.29	-0.14	-0.13	-0.15	-0.18	-0.22	-0.22
$I_{psws(300)}$	**-0.37**	**-0.40**	0.01	0.02	0.03	0.00	-0.05	-0.29	-0.05	-0.03	-0.05	-0.08	-0.13	-0.18
$I_{psws(400)}$	**-0.34**	**-0.39**	0.05	0.07	0.07	0.04	-0.01	-0.27	0.01	0.04	0.03	-0.01	-0.06	-0.14
$I_{psws(500)}$	-0.32	**-0.39**	0.11	0.13	0.14	0.11	0.04	-0.21	0.07	0.10	0.10	0.08	0.02	-0.07
$I_{psws(1000)}$	**-0.34**	**-0.40**	0.04	0.07	0.11	0.16	0.10	-0.10	0.02	0.06	0.07	0.11	0.04	-0.08
REGULAR PROACTIVE PAYMENT														
$I_{psws(100)}$	0.00	-0.06	0.27	0.30	0.23	0.23	0.17	0.05	0.25	0.28	0.29	0.31	0.23	-0.12
$I_{psws(200)}$	-0.02	-0.10	0.25	0.26	0.21	0.24	0.20	0.08	0.23	0.25	0.28	**0.34**	0.27	-0.12
$I_{psws(300)}$	-0.03	-0.13	0.22	0.25	0.22	0.26	0.22	0.12	0.20	0.22	0.28	**0.34**	0.29	-0.10
$I_{psws(400)}$	-0.07	-0.16	0.19	0.22	0.21	0.26	0.24	0.13	0.19	0.21	0.27	**0.34**	0.31	-0.08
$I_{psws(500)}$	-0.11	-0.22	0.19	0.20	0.21	0.26	0.24	0.14	0.18	0.19	0.25	0.31	0.30	-0.09
$I_{psws(1000)}$	0.11	-0.02	0.20	0.17	0.10	0.13	0.14	0.16	0.19	0.17	0.20	0.23	0.22	0.04
NO REPORTED WATER QUALITY PROBLEMS														
$I_{psws(100)}$	-0.21	-0.20	0.04	-0.01	-0.11	-0.09	-0.07	--	-0.01	-0.06	-0.10	-0.06	-0.12	-0.22
$I_{psws(200)}$	-0.18	-0.23	0.00	-0.05	-0.14	-0.13	-0.10	--	-0.04	-0.09	-0.11	-0.06	-0.12	-0.20
$I_{psws(300)}$	-0.18	-0.22	0.09	0.01	-0.09	-0.10	-0.07	--	0.03	-0.02	-0.04	0.00	-0.07	-0.20
$I_{psws(400)}$	-0.17	-0.20	0.09	0.03	-0.07	-0.09	-0.06	--	0.07	0.02	0.00	0.04	-0.02	-0.14
$I_{psws(500)}$	-0.22	-0.27	0.08	0.00	-0.08	-0.09	-0.06	--	0.07	0.01	0.01	0.04	0.00	-0.11
$I_{psws(1000)}$	-0.16	-0.33	-0.01	-0.14	-0.21	-0.20	-0.16	--	-0.03	-0.10	-0.10	-0.04	-0.11	-0.13
ONE REPORTED WATER QUALITY PROBLEM														
$I_{psws(100)}$	-0.20	-0.34	0.10	0.06	0.11	0.07	0.09	-0.31	0.04	0.04	0.06	0.03	0.01	-0.19
$I_{psws(200)}$	-0.19	**-0.36**	0.16	0.12	0.16	0.12	0.10	-0.31	0.07	0.07	0.08	0.05	0.02	-0.20
$I_{psws(300)}$	-0.21	**-0.36**	0.20	0.18	0.24	0.20	0.15	-0.31	0.11	0.12	0.15	0.12	0.09	-0.19
$I_{psws(400)}$	-0.23	**-0.37**	0.22	0.20	0.26	0.24	0.18	-0.29	0.13	0.14	0.18	0.15	0.12	-0.20
$I_{psws(500)}$	-0.24	**-0.38**	0.24	0.23	0.30	0.29	0.21	-0.22	0.15	0.17	0.22	0.19	0.17	-0.17
$I_{psws(1000)}$	-0.12	-0.22	0.25	0.25	0.32	**0.37**	0.30	-0.11	0.20	0.23	0.28	0.29	0.28	-0.07
TWO OR MORE REPORTED WATER QUALTIY PROBLEMS														
$I_{psws(100)}$	-0.03	-0.02	0.05	0.21	0.11	0.11	0.07	0.21	-0.08	0.07	-0.02	-0.06	-0.14	-0.14
$I_{psws(200)}$	0.00	-0.19	0.09	0.25	0.26	0.22	0.18	0.21	-0.02	0.10	0.08	0.09	-0.05	-0.12
$I_{psws(300)}$	-0.01	-0.20	0.08	0.24	0.29	0.24	0.19	0.21	-0.04	0.10	0.11	0.12	-0.03	-0.12
$I_{psws(400)}$	-0.03	-0.26	0.09	0.27	0.34	0.31	0.29	0.26	-0.02	0.15	0.18	0.20	0.07	-0.06
$I_{psws(500)}$	0.00	-0.20	0.10	0.27	0.33	0.28	0.28	0.26	0.03	0.23	0.24	0.25	0.13	0.02
$I_{psws(1000)}$	-0.08	-0.10	-0.02	0.19	0.26	0.30	0.33	0.35	-0.05	0.20	0.25	0.30	0.25	0.14