

Supplementary Table 1. A summary of characteristics of 313 participants with a longer observation period (94 weeks) in the RADAR-MDD study, with comparisons across the three study sites using the Kruskal-Wallis tests. Note, ethnicity data was not collected for participants recruited at the CIBER site.

| Characteristics | Total | KCL | CIBER | VUMC | p value |
|--|-------------------------|-------------------------|-------------------------|-------------------------|---------|
| Number of participants, n | 313 | 206 | 91 | 16 | |
| Age (median [IQR]) | 51.00 [37.00, 59.00] | 47.00 [32.00, 58.00] | 54.00 [47.50, 60.00] | 39.50 [33.50, 52.25] | <.001 |
| Female, n (%) | 235 (75.1) | 155 (75.2) | 67 (73.6) | 13 (81.3) | .81 |
| Marital status, n (%) | | | | | .06 |
| Single/separated/divorced/widowed | 155 (49.5) | 109 (52.9) | 36 (39.6) | 10 (62.5) | |
| Married/cohabiting/LTR | 158 (50.5) | 97 (47.1) | 55 (60.4) | 6 (37.5) | |
| Ethnicity, n (%) | | | | | <.001 |
| White | 188 (84.7) | 174 (84.5) | - | 14 (87.5) | |
| Black | 9 (4.1) | 8 (3.9) | - | 1 (6.2) | |
| Asian | 9 (4.1) | 9 (4.4) | - | 0 (0) | |
| Other | 16 (7.2) | 15 (7.3) | - | 1 (6.2) | |
| Employed, n (%) | 135 (43.1) | 106 (51.5) | 19 (20.9) | 10 (62.5) | <.001 |
| Having children, n (%) | 173 (55.3) | 97 (47.1) | 70 (76.9) | 6 (37.5) | <.001 |
| Years in education (median [IQR]) | 15.00 [12.00, 18.00] | 17.00 [14.00, 19.00] | 11.00 [9.00, 14.00] | 17.00 [15.00, 21.50] | <.001 |
| Annual income, n (%) | | | | | .003 |
| <15,000 (£/€) | 86 (27.5) | 53 (25.7) | 32 (35.2) | 1 (6.3) | |
| 15,000-55,000 (£/€) | 181 (57.8) | 116 (56.3) | 53 (58.2) | 12 (75.0) | |
| >55000 (£/€) | 44 (14.1) | 36 (17.5) | 6 (6.6) | 2 (12.5) | |
| Accommodation, n (%) | | | | | .04 |
| Own outright/with mortgage | 177 (56.6) | 105 (51.0) | 63 (69.2) | 9 (56.3) | |
| Renting | 110 (35.1) | 82 (39.8) | 21 (23.1) | 7 (43.8) | |
| Living rent-free | 23 (7.4) | 18 (8.7) | 5 (5.5) | 0 (0) | |
| Baseline PHQ8 score (median [IQR]) | 11.00 [7.00, 16.00] | 8.00 [5.25, 13.00] | 15.00 [10.00, 18.00] | 9.00 [7.00, 10.00] | <.001 |
| Having comorbidities, n (%) | 176 (56.2) | 113 (54.9) | 60 (65.9) | 3 (18.8) | .002 |
| Taking depression medication, n (%) | 208 (66.5) | 116 (56.3) | 84 (92.3) | 8 (50.0) | <.001 |
| Number of contact logs (median [IQR]) | 9.00 [6.00, 14.00] | 12.00 [8.00, 16.00] | 5.00 [3.00, 8.00] | 3.50 [2.75, 5.25] | <.001 |
| Provided phone, n (%) | 80 (25.6) | 71 (34.5) | 6 (6.7) | 3 (18.8) | <.001 |
| Smartphone brand, n (%) | | | | | <.001 |
| Motorola | 136 (43.7) | 109 (53.2) | 22 (24.4) | 5 (31.2) | |
| Samsung | 85 (27.3) | 54 (26.3) | 23 (25.6) | 8 (50.0) | |
| Other | 90 (28.9) | 42 (20.5) | 45 (50.0) | 3 (18.8) | |

Supplementary Table 2. Proportional hazards assumption tests (using the scaled Schoenfeld residuals) for 3 Cox Proportional-Hazards models of Phone-Active, Phone-Passive, and Fitbit-Passive data streams during the first 43 weeks of the RADAR-MDD study, respectively. Except “gender” variable of the Phone-Passive model, all variables passed the assumption. For the Phone-Passive model, an interaction term of the “gender” variable with a split time variable (cut points are 130 and 240) was used.

| Predictor | Phone-Active | | Phone-Passive | | Fitbit-Passive | |
|------------------------------|--------------|---------|---------------|---------|----------------|---------|
| | χ^2 | p value | χ^2 | p value | χ^2 | p value |
| Age | 0.41 | .98 | 6.14 | .19 | 6.22 | .18 |
| Gender | 0.63 | .43 | — | — | 0.67 | .41 |
| Gender strata by time | — | — | 2.91 | .41 | — | — |
| Marital status | 1.91 | .17 | 2.30 | .13 | 0.77 | .38 |
| Employment | 1.88 | .17 | 1.96 | .16 | 1.78 | .18 |
| Having children | 0.12 | .73 | 0.03 | .85 | 1.35 | .25 |
| Years in education | 2.77 | .10 | 0.05 | .82 | 0.82 | .36 |
| Annual income | 1.45 | .48 | 1.36 | .51 | 0.66 | .72 |
| Accommodation | 2.09 | .35 | 1.95 | .38 | 2.32 | .31 |
| Baseline PHQ8 score | 0.24 | .63 | 0.77 | .38 | 0.38 | .54 |
| Having comorbidities | 1.87 | .17 | 0.002 | .97 | 0.04 | .84 |
| Taking depression medication | 0.68 | .41 | 0.87 | .35 | 0.10 | .75 |
| Study Site | 0.54 | .76 | 4.07 | .13 | 4.59 | .10 |
| Brand of smartphone | 0.39 | .82 | 4.13 | .13 | 0.57 | .75 |
| Phone status | 0.06 | .80 | 0.28 | .60 | 0.61 | .44 |
| GLOBAL | 13.52 | .89 | 27.75 | .23 | 22.05 | .40 |

Supplementary Table 3. The estimates and 95% confidence intervals of hazard ratio (HR) of variables in the Cox models for assessing the impact of multiple variables of interest on the participant retention time in the first 94 weeks of the study. In the Phone-Active model, the “age” variable was split by time (the cut point is 320). For 320-660 days, compared with <30, HR of 30-39 = 0.2 (0.07-0.56) (p < .001), HR of 40-49 = 0.56 (0.28-1.15) (p = .11), HR of 50-59 = 0.24 (0.1-0.53) (p < .001), HR of >60 = 0.17 (0.07-0.41) (p < .001). For 1-319 days, all HRs of “age” were not statistically significant. Similarly, in the Fitbit-Passive model, the “children” variable was also split by time (the cut is 450); HRs of “children” were not significant in both periods.

| Variables | | Phone-Active | | Phone-Passive | | Fitbit-Passive | |
|----------------------|------------------|------------------|-----|------------------|-------|------------------|-----|
| | | HR (95% CI) | p | HR (95% CI) | p | HR (95% CI) | p |
| Age | <30 | — | — | Reference | — | Reference | — |
| | 30-39 | — | — | 0.79 (0.43-1.43) | .43 | 0.64 (0.33-1.25) | .19 |
| | 40-49 | — | — | 0.65 (0.35-1.22) | .18 | 0.48 (0.24-0.96) | .04 |
| | 50-59 | — | — | 0.71 (0.37-1.36) | .30 | 0.4 (0.2-0.83) | .01 |
| | >60 | — | — | 0.38 (0.19-0.77) | .01 | 0.38 (0.17-0.83) | .02 |
| Gender | Female | Reference | — | Reference | — | Reference | — |
| | Male | 0.74 (0.47-1.16) | .19 | 0.7 (0.47-1.05) | .09 | 0.86 (0.55-1.35) | .52 |
| Marital status | Single | Reference | — | Reference | — | Reference | — |
| | Married | 1.06 (0.68-1.66) | .79 | 1.06 (0.72-1.57) | .76 | 0.88 (0.56-1.39) | .58 |
| Employment | No | Reference | — | Reference | — | Reference | — |
| | Yes | 0.66 (0.42-1.04) | .08 | 0.78 (0.52-1.17) | .24 | 0.68 (0.43-1.08) | .10 |
| Having children | No | Reference | — | Reference | — | — | — |
| | Yes | 1.08 (0.67-1.75) | .75 | 1.05 (0.68-1.62) | .81 | — | — |
| Years in education | | 0.99 (0.95-1.03) | .69 | 1.03 (1-1.06) | .06 | 1.01 (0.97-1.04) | .68 |
| Annual income (£/€) | <15,000 | Reference | — | Reference | — | Reference | — |
| | 15,000-55,000 | 1.45 (0.91-2.31) | .12 | 1.36 (0.89-2.09) | .16 | 1.06 (0.65-1.7) | .82 |
| | >55000 | 0.98 (0.46-2.11) | .96 | 0.9 (0.46-1.74) | .75 | 0.61 (0.27-1.39) | .24 |
| Accommodation | Own outright | Reference | — | Reference | — | Reference | — |
| | Renting | 1.35 (0.88-2.06) | .17 | 1.34 (0.91-1.95) | .13 | 1.15 (0.74-1.78) | .53 |
| | Living rent-free | 0.88 (0.4-1.91) | .74 | 0.85 (0.4-1.82) | .68 | 0.65 (0.28-1.49) | .30 |
| PHQ8 score | | 1.01 (0.97-1.05) | .58 | 1.01 (0.98-1.04) | .63 | 1 (0.96-1.04) | .88 |
| Having comorbidities | No | Reference | — | Reference | — | Reference | — |
| | Yes | 0.8 (0.53-1.2) | .27 | 0.75 (0.52-1.08) | .12 | 0.79 (0.52-1.19) | .26 |
| Medication | No | Reference | — | Reference | — | Reference | — |
| | Yes | 0.79 (0.52-1.21) | .28 | 1.29 (0.86-1.93) | .22 | 0.98 (0.63-1.52) | .92 |
| Study Site | CIBER | Reference | — | Reference | — | Reference | — |
| | KCL | 0.66 (0.4-1.08) | .10 | 0.77 (0.49-1.21) | .26 | 0.71 (0.42-1.18) | .19 |
| | VUMC | 0.66 (0.27-1.61) | .37 | 0.91 (0.42-1.99) | .82 | 0.58 (0.22-1.57) | .29 |
| Brand of smartphone | Other | Reference | — | Reference | — | Reference | — |
| | Motorola | 0.6 (0.34-1.05) | .07 | 0.47 (0.29-0.76) | <.001 | 1 (0.58-1.71) | .99 |
| | Samsung | 0.85 (0.53-1.37) | .51 | 0.71 (0.47-1.07) | .10 | 0.84 (0.51-1.38) | .50 |
| Phone status | Own phone | Reference | — | Reference | — | Reference | — |
| | Provided phone | 1.4 (0.92-2.12) | .12 | 0.88 (0.58-1.33) | .54 | 0.91 (0.59-1.4) | .65 |

Supplementary Table 4. Proportional hazards assumption tests (using the scaled Schoenfeld residuals) for 3 Cox Proportional-Hazards models of Phone-Active, Phone-Passive, and Fitbit-Passive data streams during the first 94 weeks of the RADAR-MDD study, respectively. All 3 Cox models passed the global proportional hazards assumption tests. Except “age” variable of the Phone-Active model and “having children” variable of Fitbit-Passive” model, all variables passed the assumption. For the Phone-Active model, an interaction term of the “age” variable with a split time variable (the cut point is 320) was used. For the Fitbit-Passive model, an interaction term of the “having children” variable with a split time variable (the cut point is 450) was used.

| Predictor | Phone-Active | | Phone-Passive | | Fitbit-Passive | |
|--------------------------------|--------------|---------|---------------|---------|----------------|---------|
| | χ^2 | p value | χ^2 | p value | χ^2 | p value |
| Age | — | — | 1.93 | .75 | 4.61 | .33 |
| Age strata by time | 2.19 | .98 | — | — | — | — |
| Gender | 1.79 | .18 | 2.22 | .14 | 2.13 | .14 |
| Marital status | 0.23 | .63 | 0.01 | .91 | 0.64 | .42 |
| Employment | 1.06 | .30 | 0.01 | .92 | 3.28 | .07 |
| Having children | 0.58 | .45 | 1.23 | .27 | — | — |
| Having children strata by time | — | — | — | — | 1.44 | .49 |
| Years in education | 0.02 | .89 | 0.74 | .39 | 0.49 | .48 |
| Annual income | 0.51 | .78 | 0.33 | .85 | 1.90 | .39 |
| Accommodation | 1.91 | .38 | 1.48 | .48 | 1.05 | .59 |
| Baseline PHQ8 score | 0.28 | .60 | 1.36 | .24 | 0.20 | .66 |
| Having comorbidities | 1.83 | .18 | 0.09 | .76 | 0.89 | .34 |
| Taking depression medication | 2.97 | .09 | 0.64 | .42 | 0.01 | .94 |
| Study Site | 1.77 | .41 | 0.87 | .65 | 0.84 | .66 |
| Brand of smartphone | 0.71 | .70 | 0.01 | .99 | 1.83 | .40 |
| Phone status | 0.22 | .64 | 0.10 | .75 | 1.97 | .16 |
| GLOBAL | 17.68 | .86 | 13.87 | .87 | 22.75 | .42 |

Supplementary Table 5. A summary of participants' characteristics across three distinct engagement subgroups of Phone-Active data for the first 43 weeks of the RADAR-MDD study. The median and interquartile range (IQR) of continuous variables and the count number and percentage of category variables are reported in the table. All p values were assessed using the Kruskal-Wallis tests.

| Characteristics | C1 | C2 | C3 | p value |
|--|-----------------------|------------------------|-------------------------|---------|
| Number of participants, n | 231 | 179 | 204 | |
| Age | 53.00 [34.00, 61.50] | 45.00 [31.00, 55.50] | 48.00 [32.00, 57.25] | .003 |
| Male, n (%) | 52 (22.5) | 42 (23.5) | 55 (27.0) | .53 |
| Number of biweekly surveys | 20.00 [18.00, 21.00] | 13.00 [11.00, 15.00] | 4.00 [1.00, 6.00] | <.001 |
| PHQ8 response time (minutes) | 73.68 [31.31, 215.77] | 148.08 [54.05, 322.27] | 302.36 [122.30, 527.10] | <.001 |
| PHQ8 completion time (seconds) | 50.29 [37.92, 68.96] | 49.42 [40.01, 66.95] | 61.56 [46.12, 83.00] | <.001 |
| RSES response time (minutes) | 67.94 [24.11, 198.42] | 134.96 [44.55, 304.56] | 274.09 [108.18, 518.50] | <.001 |
| RSES completion time (seconds) | 54.54 [43.78, 72.39] | 55.75 [43.99, 74.28] | 69.24 [50.34, 100.52] | <.001 |
| Site, n (%) | | | | <.001 |
| CIBER | 47(20.3) | 48 (26.8) | 51 (25.0) | |
| KCL | 119 (51.5) | 102 (57.0) | 129 (63.2) | |
| VUMC | 65 (28.1) | 29 (16.2) | 24 (11.8) | |
| Married Status, n (%) | | | | .24 |
| Single/separated/divorced/widowed | 114 (49.4) | 97 (54.2) | 117 (57.4) | |
| Married/cohabiting/LTR | 117 (50.6) | 82 (45.8) | 87 (42.6) | |
| Years in education | 16.00 [12.00, 19.00] | 16.00 [13.00, 19.00] | 15.00 [12.00, 19.00] | .90 |
| Having children, n (%) | 116 (50.2) | 88 (49.2) | 100 (49.0) | .78 |
| Employed, n (%) | 90 (39.0) | 80 (44.7) | 88 (43.1) | .06 |
| Annual income, n (%) | | | | .73 |
| <15,000 (£/€) | 48 (20.8) | 48 (26.8) | 56 (27.5) | |
| 15,000-55,000 (£/€) | 135 (58.4) | 102 (57.0) | 111 (54.4) | |
| more than 55000 (£/€) | 40 (17.3) | 25 (14.0) | 33 (16.2) | |
| Accommodation, n (%) | | | | .47 |
| Own outright/with mortgage | 131 (56.7) | 90 (50.3) | 102 (50.0) | |
| Renting | 82 (35.5) | 73 (40.8) | 81 (39.7) | |
| Living rent-free | 13 (5.6) | 15 (8.4) | 18 (8.8) | |
| Baseline PHQ8 score | 9.00 [6.00, 15.00] | 10.00 [8.00, 15.00] | 13.00 [7.00, 17.00] | .003 |
| Having comorbidities, n (%) | 109 (47.2) | 86 (48.0) | 116 (56.9) | .09 |
| Taking depression medication, n (%) | 145 (62.8) | 126 (70.4) | 129 (63.2) | .22 |
| Number of contact logs | 3.00 [2.00, 5.00] | 5.00 [3.00, 7.00] | 5.00 [2.00, 9.00] | <.001 |
| Provided phone, n (%) | 55 (24.3) | 40 (22.5) | 56 (28.3) | .41 |
| Brand of smartphone, n (%) | | | | .56 |
| Motorola | 99 (43.4) | 66 (37.1) | 75 (37.7) | |
| Samsung | 72 (31.6) | 56 (31.5) | 66 (33.2) | |
| Other | 57 (25.0) | 56 (31.5) | 58 (29.1) | |

Supplementary Table 6. A summary of participants' characteristics across three distinct engagement subgroups of Phone-Passive data for the first 43 weeks of the RADAR-MDD study. The median and interquartile range (IQR) of continuous variables and the count number and percentage of category variables are reported in the table. All p values were assessed using the Kruskal-Wallis tests.

| Characteristics | C1 | C2 | C3 | p value |
|--|-------------------------|-------------------------|------------------------|---------|
| Number of participants, n | 259 | 148 | 207 | |
| Age | 52.00 [36.50, 61.00] | 46.50 [30.75, 56.25] | 46.00 [30.50, 57.50] | .01 |
| Male, n (%) | 66 (25.5) | 36 (24.3) | 47 (22.7) | .79 |
| Days with phone passive data | 283.00 [257.00, 298.00] | 167.00 [142.25, 205.25] | 32.00 [4.00, 67.50] | <.001 |
| PHQ8 response time (minutes) | 121.70 [45.13, 327.68] | 99.76 [40.89, 289.39] | 150.94 [52.23, 340.70] | .21 |
| PHQ8 completion time (seconds) | 53.63 [41.84, 72.91] | 48.08 [36.46, 66.11] | 55.29 [39.75, 74.47] | .01 |
| RSES response time (minutes) | 116.13 [36.36, 347.98] | 81.50 [31.10, 254.39] | 160.42 [39.65, 321.28] | .14 |
| RSES completion time (seconds) | 61.08 [47.33, 83.46] | 51.87 [41.31, 70.32] | 63.55 [46.68, 82.90] | .001 |
| Site, n (%) | | | | <.001 |
| CIBER | 60 (23.2) | 24 (16.2) | 62 (30.0) | |
| KCL | 165 (63.7) | 82 (55.4) | 103 (49.8) | |
| VUMC | 34 (13.1) | 42 (28.4) | 42 (20.3) | |
| Married Status, n (%) | | | | .26 |
| Single/separated/divorced/widowed | 131 (50.6) | 77 (52.0) | 120 (58.0) | |
| Married/cohabiting/LTR | 128 (49.4) | 71 (48.0) | 87 (42.0) | |
| Years in education | 15.00 [12.00, 18.00] | 17.00 [14.00, 20.00] | 16.00 [12.00, 19.00] | .005 |
| Having children, n (%) | 142 (54.8) | 66 (44.6) | 96 (46.4) | .15 |
| Employed, n (%) | 106 (40.9) | 64 (43.2) | 88 (42.5) | .87 |
| Annual income, n (%) | | | | .80 |
| <15,000 (£/€) | 65 (25.1) | 31 (20.9) | 56 (27.1) | |
| 15,000-55,000 (£/€) | 151 (58.3) | 83 (56.1) | 114 (55.1) | |
| more than 55000 (£/€) | 37 (14.3) | 29 (19.6) | 32 (15.5) | |
| Accommodation, n (%) | | | | .08 |
| Own outright/with mortgage | 150 (57.9) | 71 (48.0) | 102 (49.3) | |
| Renting | 90 (34.7) | 67 (45.3) | 79 (38.2) | |
| Living rent-free | 17 (6.6) | 7 (4.7) | 22 (10.6) | |
| Baseline PHQ8 score | 9.00 [6.00, 15.00] | 10.00 [7.00, 14.00] | 12.00 [8.00, 17.00] | .001 |
| Having comorbidities, n (%) | 135 (52.1) | 75 (50.7) | 101 (48.8) | .78 |
| Taking depression medication, n (%) | 161 (62.2) | 95 (64.2) | 144 (69.6) | .24 |
| Number of contact logs | 5.00 [2.00, 7.00] | 4.00 [2.00, 7.00] | 4.00 [2.00, 7.00] | .30 |
| Provided phone, n (%) | 84 (32.6) | 44 (29.9) | 23 (11.7) | <.001 |
| Brand of smartphone, n (%) | | | | <.001 |
| Motorola | 147 (57.0) | 63 (42.9) | 30 (15.0) | |
| Samsung | 71 (27.5) | 55 (37.4) | 68 (34.0) | |
| Other | 40 (15.5) | 29 (19.7) | 102 (51.0) | |

Supplementary Table 7. A summary of participants' characteristics across three distinct engagement subgroups of Fitbit-Passive data for the first 43 weeks of the RADAR-MDD study. The median and interquartile range (IQR) of continuous variables and the count number and percentage of category variables are reported in the table. All p values were assessed using the Kruskal-Wallis tests.

| Characteristics | C1 | C2 | C3 | p value |
|--|-------------------------|-------------------------|------------------------|---------|
| Number of participants, n | 407 | 99 | 108 | |
| Age | 48.00 [32.00, 58.50] | 45.00 [31.50, 54.00] | 51.50 [36.00, 61.00] | .06 |
| Male, n (%) | 99 (24.3) | 26 (26.3) | 24 (22.2) | .79 |
| Days with Fitbit passive data | 294.00 [274.00, 301.00] | 156.00 [132.00, 190.00] | 18.00 [0.00, 67.00] | <.001 |
| PHQ8 response time (minutes) | 113.51 [38.68, 288.84] | 170.78 [53.70, 470.75] | 161.81 [65.91, 410.24] | .007 |
| PHQ8 completion time (seconds) | 50.28 [39.19, 66.99] | 52.80 [37.71, 81.08] | 64.20 [50.71, 84.31] | <.001 |
| RSES response time (minutes) | 97.68 [29.95, 288.16] | 143.47 [56.43, 423.82] | 177.56 [65.53, 381.02] | .009 |
| RSES completion time (seconds) | 56.40 [44.29, 73.28] | 60.74 [44.95, 87.61] | 69.43 [53.61, 96.26] | <.001 |
| Site, n (%) | | | | <.001 |
| CIBER | 77 (18.9) | 29 (29.3) | 40 (37.0) | |
| KCL | 237 (58.2) | 54 (54.5) | 59 (54.6) | |
| VUMC | 93 (22.9) | 16 (16.2) | 9 (8.3) | |
| Married Status, n (%) | | | | .06 |
| Single/separated/divorced/widowed | 204 (50.1) | 61 (61.6) | 63 (58.3) | |
| Married/cohabiting/LTR | 203 (49.9) | 38 (38.4) | 45 (41.7) | |
| Years in education | 16.00 [13.00, 19.00] | 15.00 [13.00, 20.00] | 14.50 [11.00, 18.00] | .004 |
| Having children, n (%) | 191 (46.9) | 48 (48.5) | 65 (60.2) | .03 |
| Employed, n (%) | 179 (44.0) | 37 (37.4) | 42 (38.9) | .47 |
| Annual income, n (%) | | | | .08 |
| <15,000 (£/€) | 90 (22.1) | 35 (35.4) | 27 (25.0) | |
| 15,000-55,000 (£/€) | 232 (57.0) | 53 (53.5) | 63 (58.3) | |
| more than 55000 (£/€) | 75 (18.4) | 8 (8.1) | 15 (13.9) | |
| Accommodation, n (%) | | | | .30 |
| Own outright/with mortgage | 215 (52.8) | 44 (44.4) | 64 (59.3) | |
| Renting | 157 (38.6) | 46 (46.5) | 33 (30.6) | |
| Living rent-free | 30 (7.4) | 8 (8.1) | 8 (7.4) | |
| Baseline PHQ8 score | 9.00 [6.00, 15.00] | 11.00 [7.00, 16.00] | 13.00 [9.00, 17.50] | <.001 |
| Having comorbidities, n (%) | 197 (48.4) | 49 (49.5) | 65 (60.2) | .09 |
| Taking depression medication, n (%) | 264 (64.9) | 63 (63.6) | 73 (67.6) | .82 |
| Number of contact logs | 4.00 [2.00, 7.00] | 5.00 [3.00, 8.00] | 4.00 [2.00, 6.50] | .09 |
| Provided phone, n (%) | 102 (25.3) | 27 (27.6) | 22 (21.8) | .63 |
| Brand of smartphone, n (%) | | | | .047 |
| Motorola | 168 (41.6) | 39 (39.4) | 33 (32.4) | |
| Samsung | 137 (33.9) | 27 (27.3) | 30 (29.4) | |
| Other | 99 (24.5) | 33 (33.3) | 39 (38.2) | |

Supplementary Table 8. A summary of participants' characteristics across four distinct engagement subgroups of Phone-Active data for the first 94 weeks of the RADAR-MDD study. The median and interquartile range (IQR) of continuous variables and the count number and percentage of category variables are reported in the table. All p values were assessed using the Kruskal-Wallis tests.

| Characteristics | C1 | C2 | C3 | C4 | p |
|--|-----------------------|------------------------|------------------------|------------------------|-------|
| Number of participants, n | 82 | 63 | 59 | 109 | |
| Age | 56.00 [46.25, 63.00] | 49.00 [32.50, 59.00] | 48.00 [30.00, 57.50] | 47.00 [35.00, 54.00] | <.001 |
| Male, n (%) | 24 (29.3) | 15 (23.8) | 13 (22.0) | 26 (23.9) | .75 |
| Number of biweekly surveys | 41.00 [37.25, 44.00] | 25.00 [22.00, 30.00] | 18.00 [14.50, 24.00] | 5.00 [1.00, 8.00] | <.001 |
| PHQ8 response time (minutes) | 84.20 [31.44, 204.10] | 114.91 [71.77, 275.07] | 158.96 [48.80, 338.91] | 185.82 [71.58, 469.91] | .01 |
| PHQ8 completion time (seconds) | 50.78 [37.80, 66.44] | 47.26 [38.60, 57.76] | 49.67 [39.45, 64.32] | 55.58 [41.74, 81.56] | .04 |
| RSES response time (minutes) | 62.88 [25.62, 195.36] | 104.12 [41.94, 359.53] | 176.02 [40.42, 351.18] | 194.83 [53.30, 457.22] | .008 |
| RSES completion time (seconds) | 52.23 [42.13, 71.35] | 52.09 [44.01, 67.51] | 54.67 [42.18, 69.99] | 66.35 [49.14, 98.78] | <.001 |
| Site, n (%) | | | | | .001 |
| CIBER | 27 (32.9) | 14 (22.2) | 19 (32.2) | 31 (28.4) | |
| KCL | 45 (54.9) | 49 (77.8) | 35 (59.3) | 77 (70.6) | |
| VUMC | 10 (12.2) | 0 (0.0) | 5 (8.5) | 1 (0.9) | |
| Married Status, n (%) | | | | | .43 |
| Single/separated/divorced/widowed | 35 (42.7) | 33 (52.4) | 28 (47.5) | 59 (54.1) | |
| Married/cohabiting/LTR | 47 (57.3) | 30 (47.6) | 31 (52.5) | 50 (45.9) | |
| Years in education | 15.50 [12.00, 18.00] | 16.00 [12.00, 19.00] | 15.00 [12.00, 18.00] | 15.00 [12.00, 19.00] | .87 |
| Having children, n (%) | 32 (39.0) | 25 (39.7) | 28 (47.5) | 54 (49.5) | .47 |
| Employed, n (%) | 28 (34.1) | 34 (54.0) | 25 (42.4) | 48 (44.0) | .13 |
| Annual income, n (%) | | | | | .84 |
| <15,000 (£/€) | 20 (24.4) | 18 (28.6) | 18 (30.5) | 30 (27.5) | |
| 15,000-55,000 (£/€) | 50 (61.0) | 38 (60.3) | 34 (57.6) | 59 (54.1) | |
| more than 55000 (£/€) | 12 (14.6) | 7 (11.1) | 6 (10.2) | 19 (17.4) | |
| Accommodation, n (%) | | | | | .08 |
| Own outright/with mortgage | 58 (70.7) | 33 (52.4) | 31 (52.5) | 55 (50.5) | |
| Renting | 20 (24.4) | 28 (44.4) | 22 (37.3) | 40 (36.7) | |
| Living rent-free | 3 (3.7) | 2 (3.2) | 5 (8.5) | 13 (11.9) | |
| Baseline PHQ8 score | 9.00 [5.75, 13.00] | 10.00 [7.00, 14.00] | 13.00 [8.50, 17.50] | 13.00 [7.00, 17.00] | .005 |
| Having comorbidities, n (%) | 39 (47.6) | 39 (61.9) | 32 (54.2) | 66 (60.6) | .24 |
| Taking depression medication, n (%) | 57 (69.5) | 38 (60.3) | 41 (69.5) | 72 (66.1) | .65 |
| Number of contact logs | 7.00 [5.00, 10.00] | 11.00 [7.00, 17.00] | 9.00 [5.00, 13.50] | 10.00 [5.00, 14.00] | .002 |
| Provided phone, n (%) | 17 (20.7) | 17 (27.0) | 12 (20.3) | 34 (31.5) | .27 |
| Brand of smartphone, n (%) | | | | | .13 |
| Motorola | 45 (55.6) | 23 (36.5) | 22 (37.3) | 46 (42.6) | |
| Samsung | 17 (21.0) | 18 (28.6) | 15 (25.4) | 35 (32.4) | |
| Other | 19 (23.5) | 22 (34.9) | 22 (37.3) | 27 (25.0) | |

Supplementary Table 9. A summary of participants' characteristics across four distinct engagement subgroups of Phone-Passive data for the first 94 weeks of the RADAR-MDD study. The median and interquartile range (IQR) of continuous variables and the count number and percentage of category variables are reported in the table. All p values were assessed using the Kruskal-Wallis tests.

| Characteristics | C1 | C2 | C3 | C4 | p |
|--|-------------------------|-------------------------|-------------------------|------------------------|-------|
| Number of participants, n | 122 | 53 | 61 | 77 | |
| Age | 54.00 [41.00, 62.75] | 46.00 [35.00, 53.00] | 48.00 [37.00, 55.00] | 50.00 [36.00, 59.00] | .009 |
| Male, n (%) | 33 (27.0) | 9 (17.0) | 16 (26.2) | 20 (26.0) | .54 |
| Days with phone passive data | 607.00 [538.25, 639.00] | 417.00 [362.00, 465.00] | 230.00 [179.00, 286.00] | 31.00 [3.00, 86.00] | <.001 |
| PHQ8 response time (minutes) | 107.42 [40.78, 320.76] | 123.17 [35.15, 246.15] | 107.89 [37.38, 329.76] | 174.82 [63.87, 261.17] | .81 |
| PHQ8 completion time (seconds) | 51.78 [41.09, 66.86] | 47.00 [37.99, 61.73] | 46.49 [37.06, 61.44] | 55.58 [41.17, 75.53] | .16 |
| RSES response time (minutes) | 105.32 [33.88, 336.49] | 104.53 [21.69, 290.55] | 83.92 [33.37, 280.32] | 178.30 [64.61, 336.32] | .55 |
| RSES completion time (seconds) | 57.42 [45.97, 74.53] | 53.36 [43.56, 68.84] | 50.79 [41.02, 72.28] | 64.11 [48.09, 97.14] | .06 |
| Site, n (%) | | | | | .007 |
| CIBER | 26 (21.3) | 15 (28.3) | 17 (27.9) | 33 (42.9) | |
| KCL | 92 (75.4) | 35 (66.0) | 37 (60.7) | 42 (54.5) | |
| VUMC | 4 (3.3) | 3 (5.7) | 7 (11.5) | 2 (2.6) | |
| Married Status, n (%) | | | | | .85 |
| Single/separated/divorced/widowed | 60 (49.2) | 24 (45.3) | 30 (49.2) | 41 (53.2) | |
| Married/cohabiting/LTR | 62 (50.8) | 29 (54.7) | 31 (50.8) | 36 (46.8) | |
| Years in education | 14.50 [12.00, 18.00] | 17.00 [13.00, 18.00] | 16.00 [13.00, 19.00] | 15.00 [12.00, 19.00] | .55 |
| Having children, n (%) | 69 (56.6) | 26 (49.1) | 35 (57.4) | 43 (55.8) | .85 |
| Employed, n (%) | 52 (42.6) | 24 (45.3) | 29 (47.5) | 30 (39.0) | .89 |
| Annual income, n (%) | | | | | .15 |
| <15,000 (£/€) | 32 (26.2) | 14 (26.4) | 15 (24.6) | 25 (32.5) | |
| 15,000-55,000 (£/€) | 69 (56.6) | 29 (54.7) | 39 (63.9) | 44 (57.1) | |
| more than 55000 (£/€) | 21 (17.2) | 8 (15.1) | 7 (11.5) | 8 (10.4) | |
| Accommodation, n (%) | | | | | .82 |
| Own outright/with mortgage | 71 (58.2) | 32 (60.4) | 33 (54.1) | 41 (53.2) | |
| Renting | 41 (33.6) | 18 (34.0) | 23 (37.7) | 28 (36.4) | |
| Living rent-free | 10 (8.2) | 3 (5.7) | 4 (6.6) | 6 (7.8) | |
| Baseline PHQ8 score | 8.50 [5.25, 14.00] | 11.00 [6.00, 17.00] | 10.50 [7.25, 15.75] | 13.00 [9.00, 17.00] | .02 |
| Having comorbidities, n (%) | 74 (60.7) | 26 (49.1) | 33 (54.1) | 43 (55.8) | .53 |
| Taking depression medication, n (%) | 73 (59.8) | 36 (67.9) | 44 (72.1) | 55 (71.4) | .24 |
| Number of contact logs | 10.50 [7.00, 17.00] | 9.00 [6.00, 14.00] | 10.00 [6.00, 15.00] | 6.00 [3.00, 10.00] | <.001 |
| Provided phone, n (%) | 39 (32.0) | 16 (30.2) | 16 (26.2) | 9 (11.8) | .01 |
| Brand of smartphone, n (%) | | | | | <.001 |
| Motorola | 81 (66.9) | 22 (41.5) | 19 (31.1) | 14 (18.4) | |
| Samsung | 17 (14.0) | 11 (20.8) | 19 (31.1) | 43 (56.6) | |
| Other | 23 (19.0) | 20 (37.7) | 23 (37.7) | 19 (25.0) | |

Supplementary Table 10. A summary of participants' s characteristics across four distinct engagement subgroups of Fitbit-Passive data for the first 94 weeks of the RADAR-MDD study. The median and interquartile range (IQR) of continuous variables and the count number and percentage of category variables are reported in the table. All p values were assessed using the Kruskal-Wallis tests.

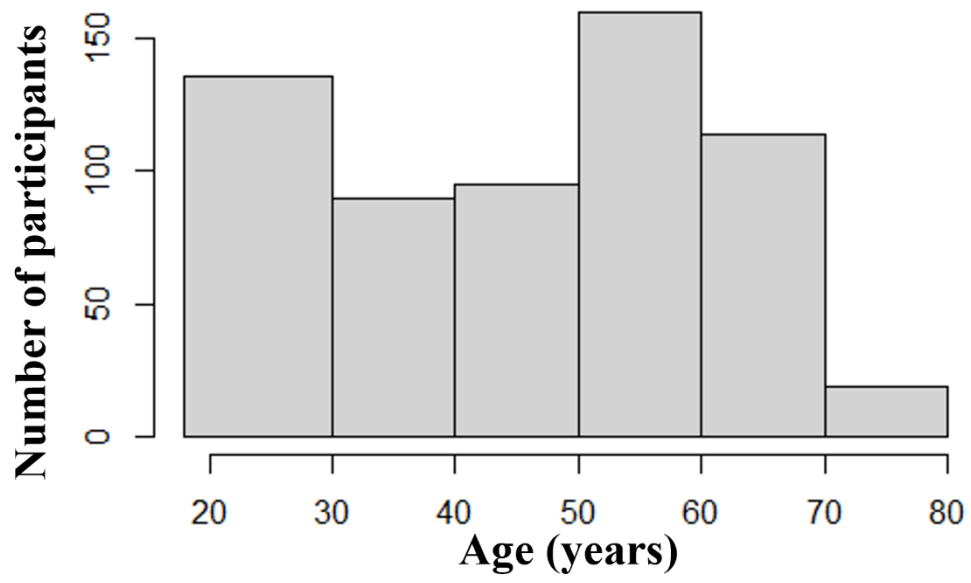
| Characteristics | C1 | C2 | C3 | C4 | p |
|--|-------------------------|-------------------------|-------------------------|------------------------|-------|
| Number of participants, n | 153 | 58 | 52 | 50 | |
| Age | 53.00 [40.00, 60.00] | 45.00 [32.00, 54.75] | 43.00 [30.50, 53.00] | 54.50 [40.75, 63.00] | <.001 |
| Male, n (%) | 38 (24.8) | 18 (31.0) | 10 (19.2) | 12 (24.0) | .56 |
| Days with Fitbit passive data | 634.00 [586.00, 655.00] | 426.50 [358.25, 480.00] | 218.00 [162.75, 264.00] | 61.50 [2.50, 100.50] | <.001 |
| PHQ8 response time (minutes) | 106.57 [38.25, 252.87] | 166.12 [59.78, 305.03] | 198.13 [39.73, 378.89] | 160.82 [63.15, 259.01] | .56 |
| PHQ8 completion time (seconds) | 47.46 [39.41, 58.66] | 48.08 [39.29, 63.49] | 57.93 [41.96, 77.13] | 67.27 [48.78, 92.50] | .001 |
| RSES response time (minutes) | 100.70 [27.77, 234.81] | 143.48 [38.42, 316.74] | 180.24 [18.92, 425.51] | 149.08 [50.24, 331.34] | .56 |
| RSES completion time (seconds) | 52.44 [43.61, 66.07] | 53.18 [42.18, 73.52] | 67.99 [48.09, 94.11] | 71.15 [54.14, 106.58] | .001 |
| Site, n (%) | | | | | .11 |
| CIBER | 35 (22.9) | 15 (25.9) | 20 (38.5) | 21 (42.0) | |
| KCL | 109 (71.2) | 39 (67.2) | 30 (57.7) | 28 (56.0) | |
| VUMC | 9 (5.9) | 4 (6.9) | 2 (3.8) | 1 (2.0) | |
| Married Status, n (%) | | | | | .39 |
| Single/separated/divorced/widowed | 70 (45.8) | 34 (58.6) | 27 (51.9) | 24 (48.0) | |
| Married/cohabiting/LTR | 83(54.2) | 24 (41.4) | 25 (48.1) | 26 (52.0) | |
| Years in education | 16.00 [12.00, 19.00] | 15.00 [13.00, 18.00] | 15.00 [12.00, 20.00] | 14.00 [11.00, 17.00] | .19 |
| Having children, n (%) | 84 (54.9) | 27 (46.6) | 26 (50.0) | 36 (72.0) | .17 |
| Employed, n (%) | 74 (48.4) | 24 (41.4) | 18 (34.6) | 19 (38.0) | .27 |
| Annual income, n (%) | | | | | .32 |
| <15,000 (£/€) | 37 (24.2) | 17 (29.3) | 17 (32.7) | 15 (30.0) | |
| 15,000-55,000 (£/€) | 87 (56.9) | 34 (58.6) | 31 (59.6) | 29 (58.0) | |
| more than 55000 (£/€) | 29 (19.0) | 6 (10.3) | 4 (7.7) | 5 (10.0) | |
| Accommodation, n (%) | | | | | .08 |
| Own outright/with mortgage | 94 (61.4) | 26 (44.8) | 23 (44.2) | 34 (68.0) | |
| Renting | 50 (32.7) | 23 (39.7) | 24 (46.2) | 13 (26.0) | |
| Living rent-free | 8 (5.2) | 8 (13.8) | 5 (9.6) | 2 (4.0) | |
| Baseline PHQ8 score | 9.00 [7.00, 13.75] | 12.00 [6.00, 18.00] | 13.00 [7.00, 17.00] | 13.00 [8.75, 17.00] | .11 |
| Having comorbidities, n (%) | 81 (52.9) | 31 (53.4) | 27 (51.9) | 37 (74.0) | .05 |
| Taking depression medication, n (%) | 102 (66.7) | 37 (63.8) | 37 (71.2) | 32 (64.0) | .84 |
| Number of contact logs | 10.00 [7.00, 16.00] | 8.00 [5.00, 14.00] | 9.00 [5.75, 12.25] | 6.00 [3.00, 9.75] | <.001 |
| Provided phone, n (%) | 40 (26.1) | 16 (27.6) | 12 (23.1) | 12 (24.5) | .95 |
| Brand of smartphone, n (%) | | | | | .45 |
| Motorola | 72 (47.4) | 27 (46.6) | 20 (38.5) | 17 (34.7) | |
| Samsung | 39 (25.7) | 17 (29.3) | 17 (32.7) | 12 (24.5) | |
| Other | 41 (27.0) | 14 (24.1) | 15 (28.8) | 20 (40.8) | |

Supplementary Table 11. A summary of ethnicity difference across three distinct engagement subgroups of Phone-Active, Phone-Passive, and Fitbit-Passive data streams for the first 43 weeks of the RADAR-MDD study (ethnicity data was available for KCL and VUMC sites). All p values were assessed using the Kruskal-Wallis tests.

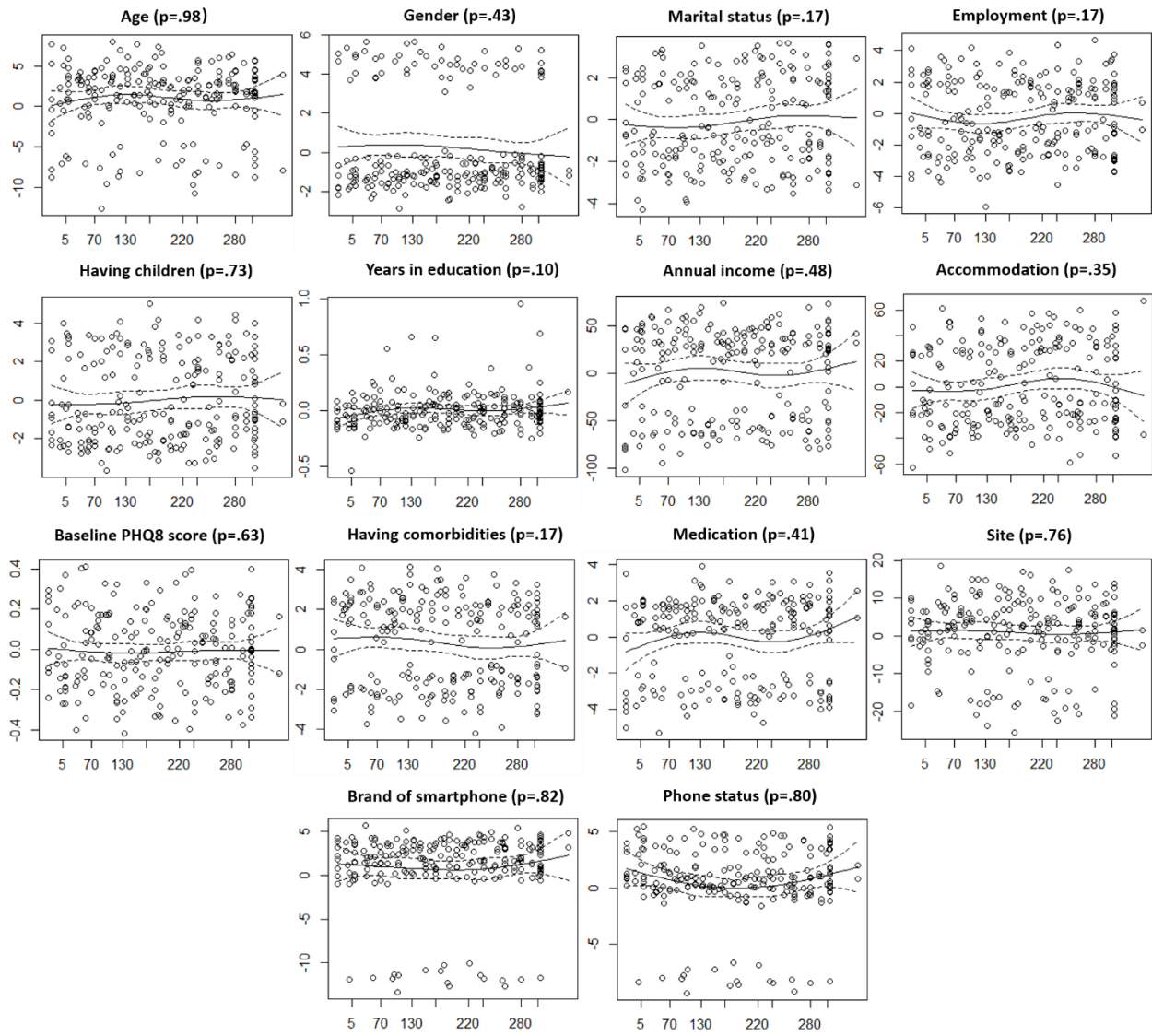
| Data stream | C1 | C2 | C3 | p value |
|-----------------------|-------------|-------------|-------------|----------------|
| Phone-Active | | | | <.001 |
| White | 175 (95.1%) | 110 (84.0%) | 119 (77.8%) | |
| Black | 3 (1.6%) | 3 (2.3%) | 8 (5.2%) | |
| Asian | 2 (1.1%) | 2 (1.5%) | 12 (7.8%) | |
| Other | 4 (2.2%) | 16 (12.2%) | 14 (9.2%) | |
| Phone-Passive | | | | .001 |
| White | 174 (87.4%) | 115 (92.7%) | 115 (79.3%) | |
| Black | 10 (5.0%) | 1 (0.8%) | 3 (2.1%) | |
| Asian | 2 (1.0%) | 4 (3.2%) | 10 (6.9%) | |
| Other | 13 (6.5%) | 4 (3.2%) | 17 (11.7%) | |
| Fitbit-Passive | | | | .003 |
| White | 296 (89.7%) | 57 (81.4%) | 51 (75.0%) | |
| Black | 9 (2.7%) | 4 (5.7%) | 1 (1.5%) | |
| Asian | 6 (1.8%) | 4 (5.7%) | 6 (8.8%) | |
| Other | 19 (5.8%) | 5 (7.1%) | 10 (14.7%) | |

Supplementary Table 12. A list of 19 comorbidities that recorded at the enrollment of the RADAR-MDD study.

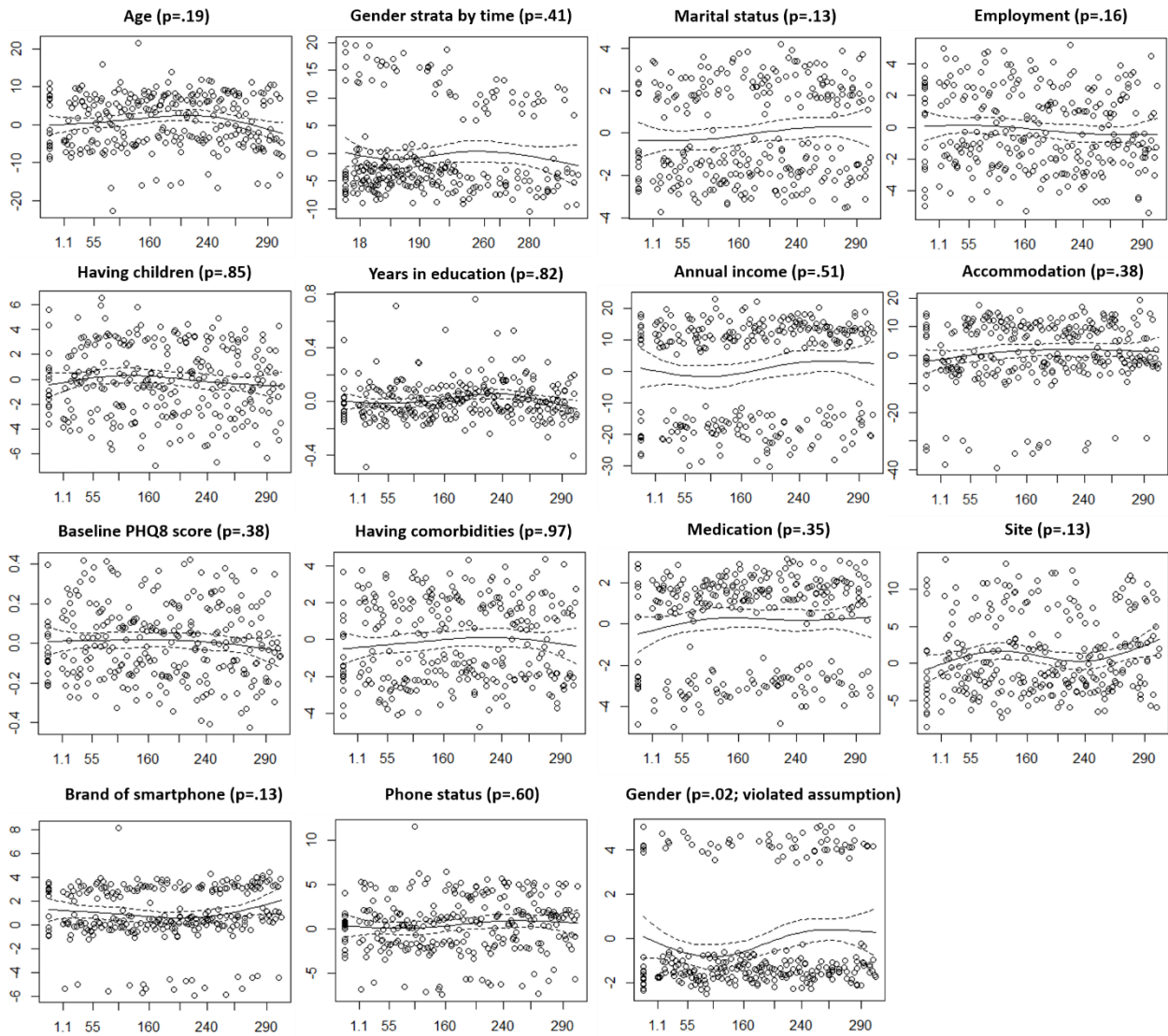
| Number | Comorbidity |
|---------------|-------------------------------------|
| 1 | Asthma |
| 2 | Chronic bronchitis |
| 3 | Other chest trouble |
| 4 | Diabetes |
| 5 | Stomach or other digestive disorder |
| 6 | Liver trouble |
| 7 | Kidney trouble |
| 8 | Rheumatoid arthritis |
| 9 | Osteoarthritis |
| 10 | Heart trouble |
| 11 | Cancer |
| 12 | High blood pressure |
| 13 | Multiple Sclerosis |
| 14 | Epilepsy/fits |
| 15 | Stroke |
| 16 | Other neurological trouble |
| 17 | Migraine |
| 18 | Back trouble |
| 19 | Other |



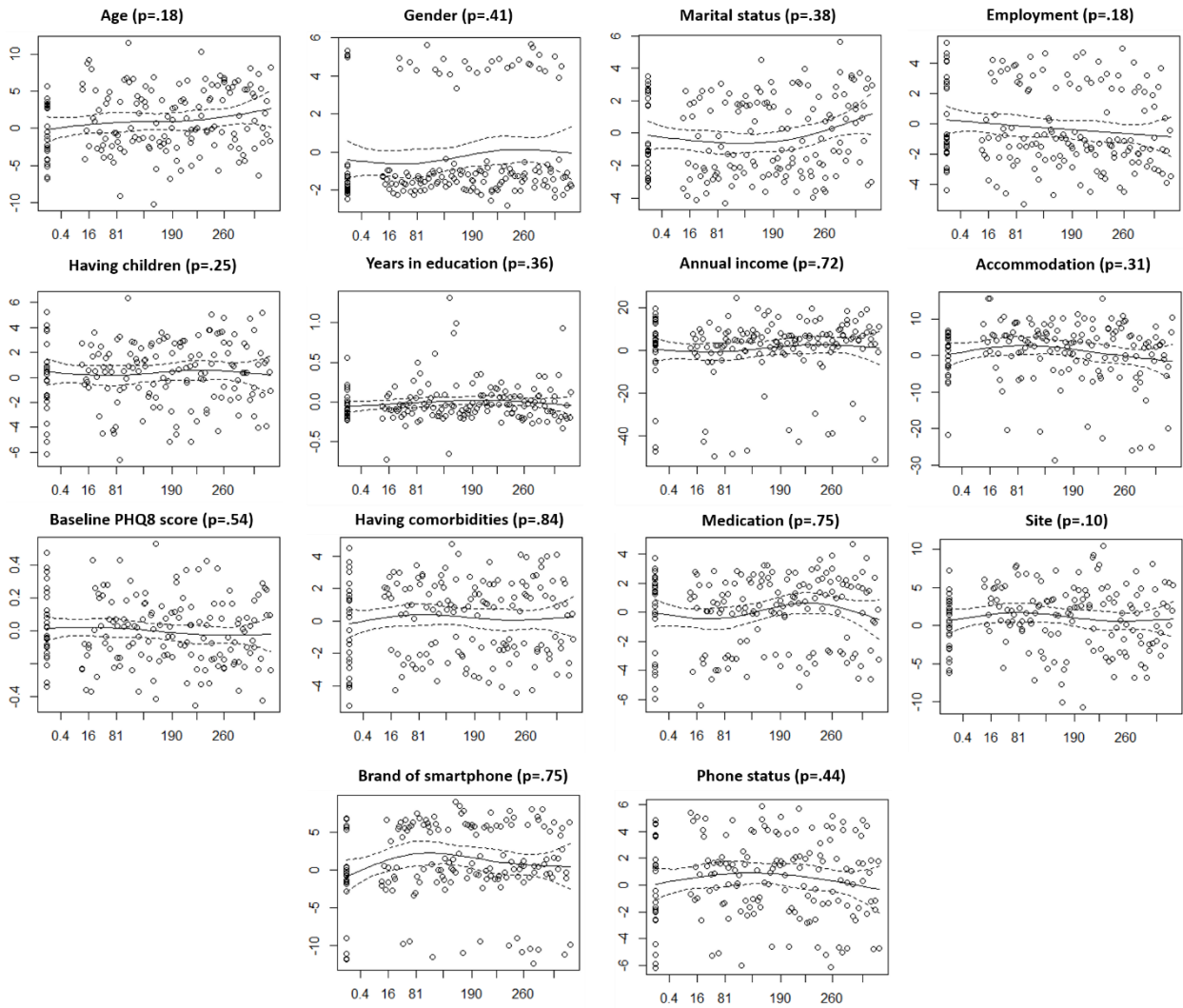
Supplementary Figure 1. The histogram of age distribution for 614 participants in the RADAR-MDD study.



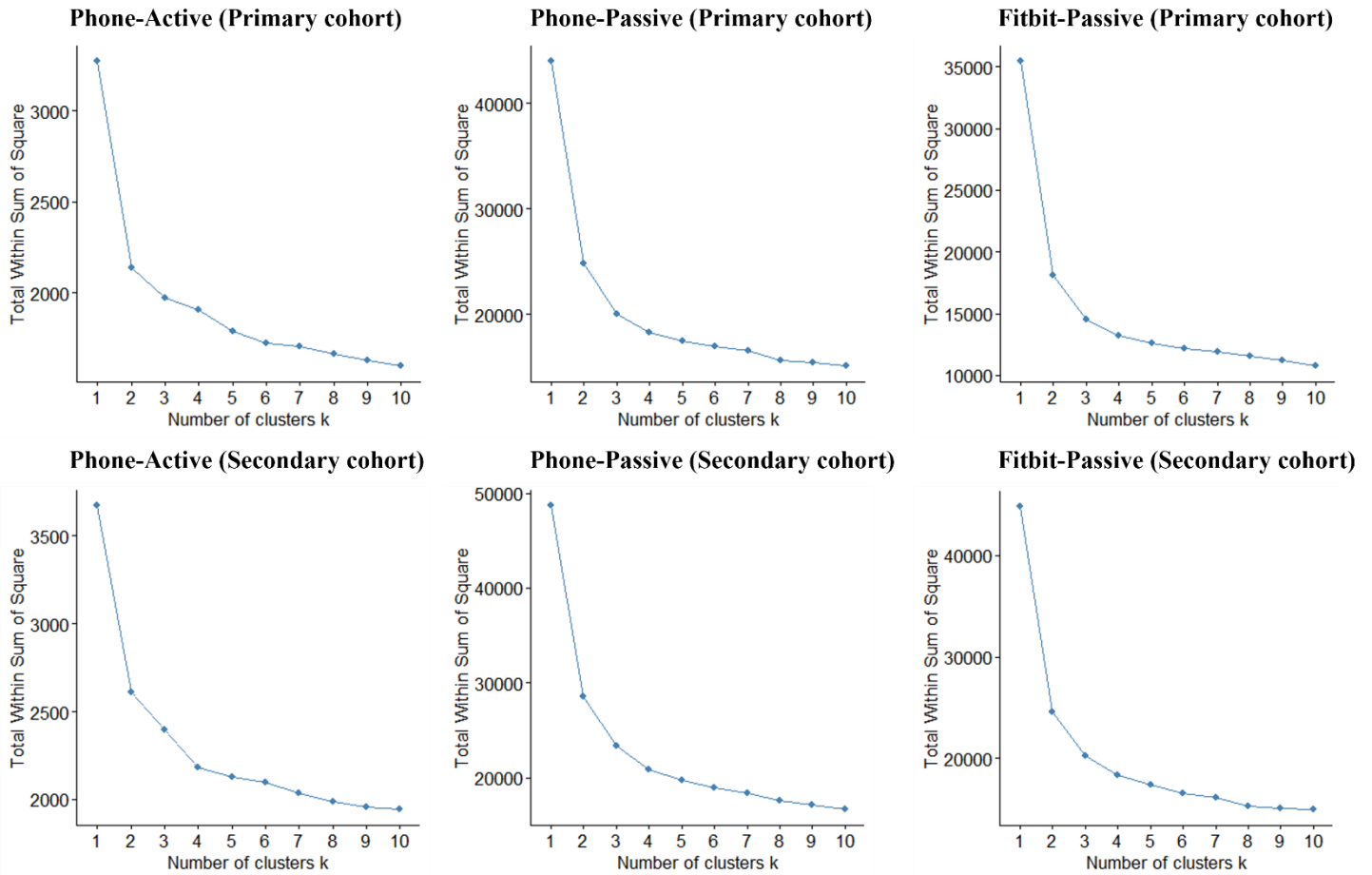
Supplementary Figure 2. Scaled Schoenfeld residual plots for all variables in Cox Proportional-Hazard model for the Phone-Active data stream for the first 43 weeks of the study. The results of proportional hazard assumption tests are shown in Supplement Table 2. All variables passed the assumption test.



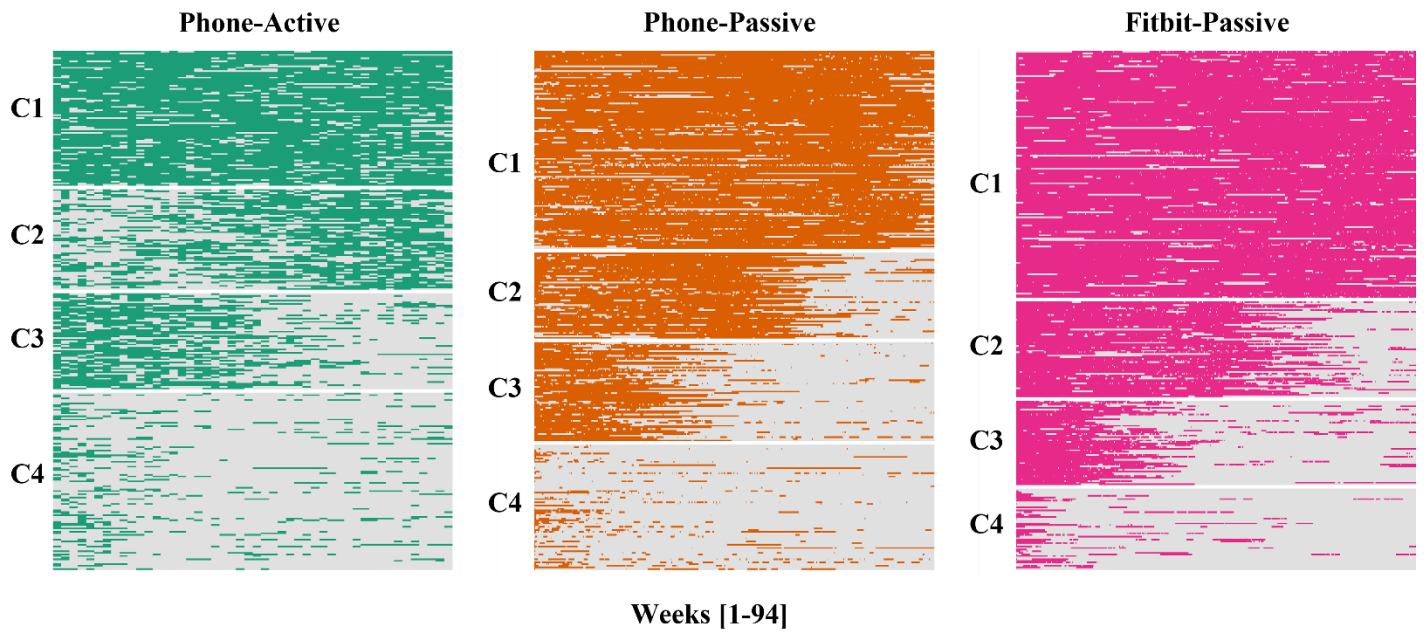
Supplementary Figure 3. Scaled Schoenfeld residual plots for all variables in Cox Proportional-Hazard model for the Phone-Passive data stream for the first 43 weeks of the study. The results of proportional hazard assumption tests are shown in Supplement Table 2. An interaction term of the “gender” variable with a split time variable (cut points are 130 and 240) was used to make the variable meet the model assumption. The previous scaled Schoenfeld residual plot (violated the assumption) of “gender” is shown in the last subplot.



Supplementary Figure 4. Scaled Schoenfeld residual plots for all variables in Cox Proportional-Hazard model for the Fitbit-Passive data stream for the first 43 weeks of the study. The results of proportional hazard assumption tests are shown in Supplement Table 2. All variables passed the assumption test.



Supplementary Figure 5. Comparison of within-cluster variations across data streams using different cluster sizes (N=1-10) for K-means clustering. The optimal numbers of clusters for primary (43-week observation period) and secondary (94-week observation period) cohorts are 3 and 4, respectively.



Supplementary Figure 6. Heatmaps of participant longitudinal engagement patterns for the three data streams in the longer observation period (94 weeks), clustered using K-means clustering. In each heatmap, each row represents a data-availability vector of one participant (described in Methods), and subgroups were arranged from the most engaged cluster to the least engaged cluster (C1-C4).