1   **Customizing place-tailored messaging using a multi-level approach: Pilot study of the Step**

2   **It Up physical activity mobile app tailored to neighborhood environment**

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14 **SUPPLEMENTAL METHODS**

15 **1. Community Engagement and Recruitment Process**

16 Community engagement is a fundamental facet of our research and we first sought to develop

17 partnerships with faith-based organizations, health care organizations, academic institutions, and

18 other community-based organizations aiming to improve cardiovascular health. This led to the

19 development of the DC Cardiovascular Health and Obesity Collaborative (DC CHOC)

20 community advisory board, with whom we partnered in the development and implementation of

21 the Washington DC Cardiovascular Health and Needs Assessment (DC CHNA), which was

22 crucial to understand community cardiovascular health and the feasibility of using digital health

23 tools for improving cardiovascular health for the development of the Step It Up app and

24   intervention.[4] For the development of the Step It Up app, DC CHOC also provided feedback and

25   advice for app design and function. Specifically, we emailed a questionnaire to the members of

26   DC CHOC, followed by telephone interviews to identify barriers to PA and solicit suggestions

27   for motivational messaging to encourage PA; these messages are being used in the app. We also

28   got feedback from DC CHOC on community-based PA locations to include for the tailored-to-

29   place messaging that might not be found in internet searches.[4] After implementing the pilot

30   intervention, we conducted surveys where participants provided information about their

31   experiences with the app. We therefore sought feedback from the community both before and

32   after the implementation of the pilot.

33

34   Participant recruitment information can be found in our previous publications, wherein we

35   described building our community partnerships with the DC CHOC community advisory board

36   and how we implemented the Communication, Awareness, Relationships, and Empowerment

37   (C.A.R.E.) model in our recruitment efforts in the community.[4] Briefly, we had a diverse

38   research team in implementing the study who were chosen for their professional expertise,

39   knowledge, and experience working with populations from limited-resource communities.

40   Recruitment efforts were led by a community outreach coordinator. The coordinator developed

41   and maintained relationships with DC CHOC, local health advocacy groups, and other

42   community-based organizations working with African Americans so that those in these groups

43   were aware of the study and could send potential participants to the outreach coordinator for

44   additional information and possible enrollment. The study has been advertised at different

45   outreach events in the DC area through flyers, social media posts, and community presentations

46   in each phase of study implementation. We have also sought to empower the community by

47 engaging with DC CHOC on each step in the design of Step It Up so that members could provide

48 input on the study design; we seek to empower study participants by making sure they have

49 access to their cardiovascular health data collected as a part of the study so they understand their

50 individual cardiovascular risk and can share that information with their health care providers.

51

52 **2. Multi-Level Framework**

53 The Step It Up app was designed based on a multi-level framework, where messaging can be

54 provided to address individual-level barriers to PA (standard messaging) and neighborhood-level

55 barriers to PA (tailored-to-place messaging). While the Step It Up app does not directly facilitate

56 true upstream changes in the environment or policy, it does serve to increase the awareness and

57 utilization of physical activity resources available in target communities. Because neighborhood

58 physical resources may be lacking for our participants in deprived neighborhoods, the available

59 gyms, parks, recreation centners, and other PA resources become all the more valuable. By

60 incorporating tailored-to-place messages, we hope to increase both awareness and utilization of

61 these valuable PA resources. In fact, participants have expressed that these messages were useful

62 to discover PA resources, which was associated with favorable neighborhood perceptions.

63 Additionally, we foresee the data we collect on the use of community PA resources will be

64 useful in the development of true environmental interventions, informing future projects which

65 may aim to increase and optimize physical activity resources of neighborhoods and communities.

66 **Figure S1** describes our multi-level framework from a previous publication.[4]

67

68 **3. Tailored-to-Place Messages**

69 3a. Location Registry

70 There are two sources of locations for tailored-to-place messaging. The first source was

71 compiled by the research team and includes numerous local gyms, recreation centers, parks, and

72 trails in areas where participants live. This first source of locations also included PA locations

73 identified through feedback from the community advisory board with whom we work, such as

74 church locations with fitness classes that might not be found through internet searches.[4] Push

75 notifications were sent to participants upon entering a 1200m radius of the location, and these

76 locations were used for all participants. The second source of locations is provided by

77 participants themselves and not available to other participants. These participant-specific

78 locations include formal locations for physical activity but also informal PA spaces such as

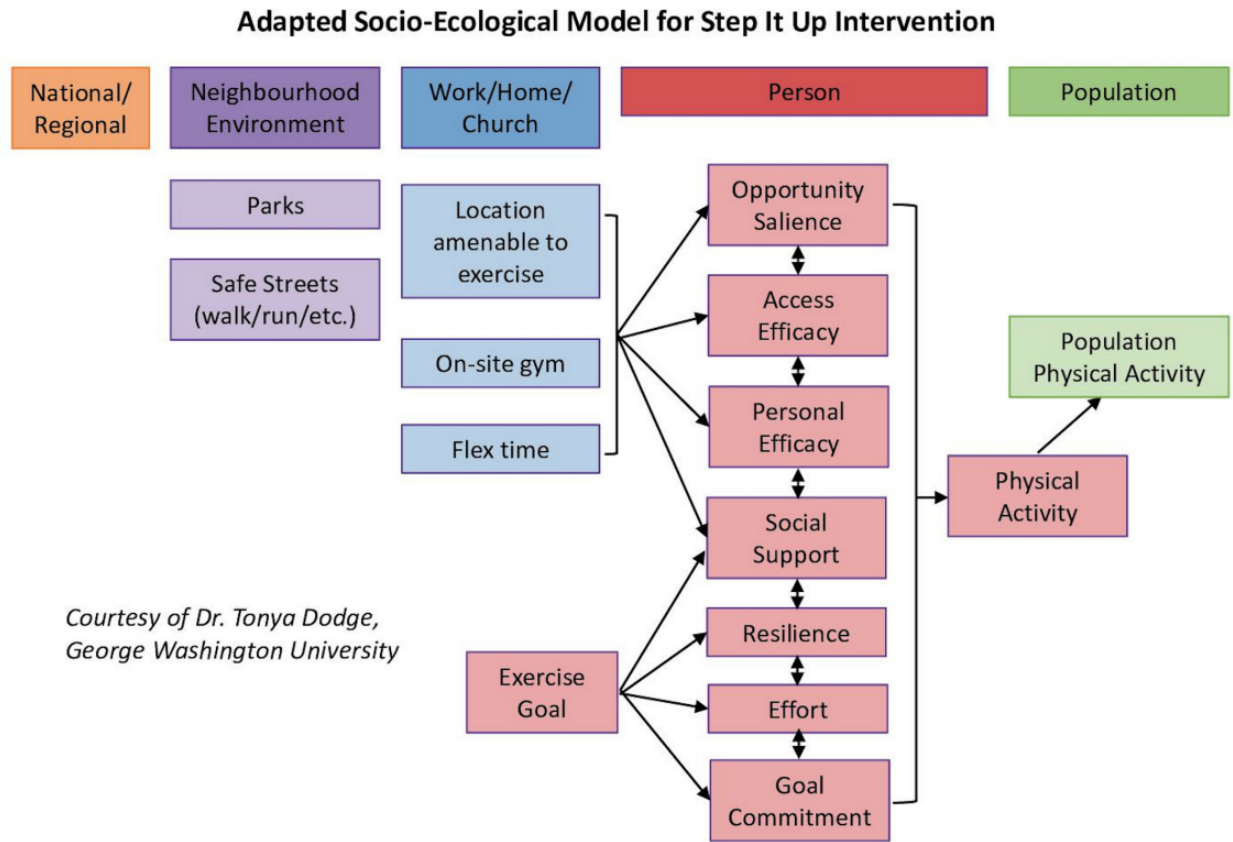79 schools, homes, and workplaces.

80

81 3b. Reporting Unsafe Locations

82 We have developed a feature that allows users to flag unsafe locations upon receiving a tailored-

83 to-place message for that location (**Figure S2**). Reporting of unsafe locations are fully

84 determined by user discretion and not administrator approval, allowing the user base to

85 collectively determine acceptable levels of safety in PA resources. The definition of unsafe is

86 based on user perceptions, not only about crime but also factors such as lack of lighting, unlevel

87 sidewalks, and presence of dogs. Upon flagging by one user, the location is removed from the

88 registry for all users. Trust in the community to report unsafe locations may be supported by the

89 open community forum available within the app, where participants can post discussion topics

90 and participate in reply threads. We hope to build this community of app users, not only to

91 facilitate trust in the process of reporting unsafe locations, but to begin improving SDoH like

92 neighborhood social cohesion.

93   The option to flag unsafe locations was added as a result of the findings from this pilot study and

94   we will analyze how participating in location flagging is associated with changes in

95   neighborhood perception in the full study. We hypothesize that the ability to flag unsafe

96   locations and the knowledge that unsafe locations are promptly removed may improve user

97   perception of neighborhood safety.

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SUPPLEMENTAL MATERIALS

Adapted Socio-Ecological Model for Step It Up Intervention

Courtesy of Dr. Tonya Dodge, George Washington University

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Figure S1. Adapted socioecological model that accounts for various factors affecting an

individual's decision to engage in physical activity. Tailored-to-place messaging will focus on

the neighborhood environment and work/home/church levels of the socioecological model, while

standard-remote messaging focuses on the person-level.[4]

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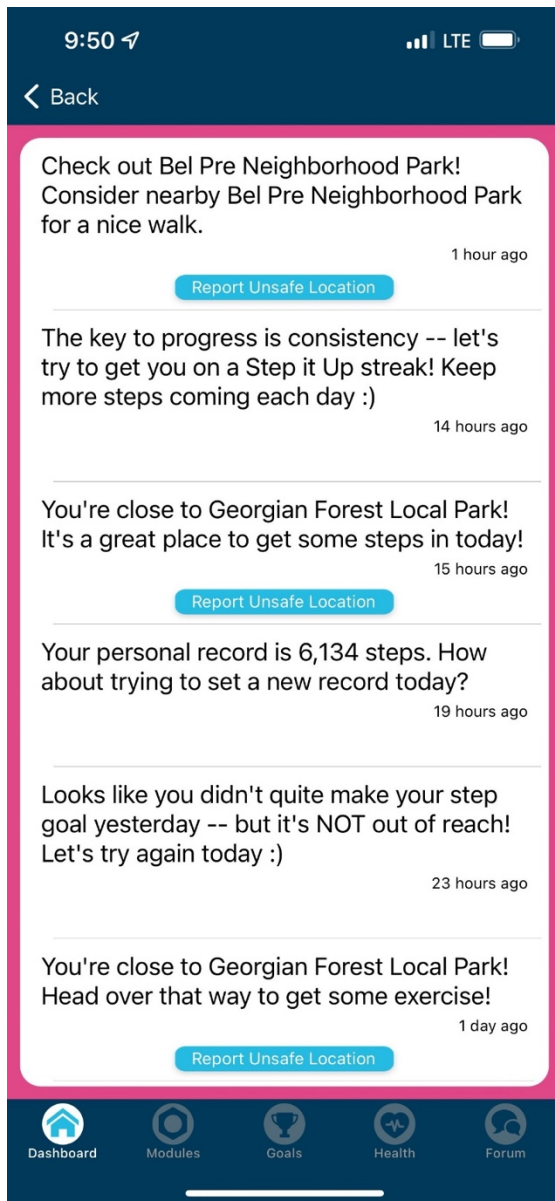
Figure S2. Displayed here is the Message Center of the Step It Up app. The complete history of

Step It Up notifications are visible here, including tailored-to-place messages. Seen below the

tailored-to-place messages is a button, "Report Unsafe Location", that participants can use to

flag unsafe locations.

SUPPLEMENTAL TABLE

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115 **Table S1.** Baseline patient characteristics (n=24) focused on AA women living in lower-

116 resourced neighborhoods within the Washington, D.C. metropolitan area (Wards 5, 7, 8, and the

117 contiguous Prince George's County, MD). Continuous variables are reported as Mean ± SD,

118 while categorical variables are shown as N (%).

		Participants (N=24)
Individual Characteristics	Age, years	57.0 (±12.4)
	Female, N (%)	24 (100)
	Race, African American, N (%)	24 (100)
Education	College or more	23 (95.8%)
	High school graduate	1 (4.2%)
	Less than high school	0 (0%)
Income	≥$60,000/year	15 (62.5%)
	<$60,000/year	7 (29.2%)
	Not reported	2 (8.3%)
Health-related factors	BMI*	34.8 (±6.3)
	Daily Steps	8535.9 (±3566.6)
Psychosocial/Environmental Factors	Social Isolation	0.3 (±0.5)
	Social Cohesion	14.3 (±3.7)
	Safety	3.7 (±1.0)
App Use	Engagement	9.8 (±6.4)

119 *BMI: Body Mass Index

120 **Table S2.** Average wear time of Fitbit in hours per day, for Week 1, 2, and 3 of the pilot. The

121 detection of a heartrate per minute of the day was used to calculate the total amount of time a

122 Fitbit was worn. Minutes where heartrate was not detected were not counted towards wear time.

	Average wear time (hours per day)			
Participant ID	Week 1	Week 2	Week 3	Weeks 1-3
1	21.08	20.79	18.29	20.05
2	23.15	23.26	23.53	23.31
3	20.97	23.50	22.87	22.45
4	17.45	20.52	15.31	17.76
5	21.16	22.76	22.44	22.12
6	22.81	22.91	23.68	23.13
7	23.37	23.02	22.81	23.07
8	22.27	23.26	23.46	23.00
9	21.51	22.34	21.14	21.66
10	23.61	23.65	23.61	23.62
11	19.60	22.04	21.87	21.17
12	23.32	23.40	23.65	23.46
13	19.05	21.99	20.04	20.36
14	16.01	18.46	14.61	16.36
15	23.33	23.50	23.71	23.51
16	15.85	15.96	15.02	15.61
17	23.62	22.27	23.44	23.11
18	21.41	21.41	22.69	21.84

19	14.22	20.03	21.56	18.60
20	22.07	18.24	20.95	20.42
21	22.75	22.51	19.66	21.64
22	18.67	19.92	6.30	14.96
23	23.49	21.41	16.08	20.33
24	22.86	20.90	20.50	21.42
All participants	20.99	21.59	20.30	20.96

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124

125 **Table S3.** Characteristics and Associations of Neighborhood Environment by Engagement,

126 adjusted for Age and BMI. (Highlighted in "bold" font indicates significance)

	Fully adjusted model (Age, BMI*)	
	Parameter Estimate	p-value
Social Isolation	5.2 (2.4)	**0.04**
Social Cohesion	3.5 (1.4)	**0.02**
Safety	3.0 (1.3)	**0.03**

127 *BMI – body mass index

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