Supplemental Materials I. Research Protocol for Pilot Study on Wearables: TOPOWA

1. **Rationale for proposed research**

Over 50% of the urban population in Kampala lives in slum communities (United Nations Human Settlements Programme and Kampala City Council 2007) and many adolescent girls and young women (AGYW) in these communities are faced with health-related challenges which affect their mental health, such as risky sexual behaviors, crime, violence, alcohol and substance use (Culbreth et al. 2021; Swahn et al. 2019, 2021). In order to improve their wellbeing, interventions such as Socioeconomic Strengthening Targeted Training (SeSTT), which Uganda Youth Development Link (UYDEL) is implementing, are important. Findings from the TOPOWA study will establish key social and environmental factors that change upon SeSTT among AGYW and inform future interventions geared towards improving mental health in slum communities. This pilot study was designed to provide preliminary feasibility data prior to the 27-month cohort study.

1. **Objectives**

B.1. Objective of Overall Study

The overall goal of the TOPOWA project is to examine how SeSTT may buffer against the effects of adverse experiences and proximal social and environmental stressors among young women ages 18-24 in Kampala, Uganda.

B.2. Specific Objectives of this Pilot Study

The objective of this pilot study was to assess the feasibility and acceptability of using wearable devices and daily diaries to assess sleep and activity space of AGYW in slum communities in Kampala, Uganda.

1. **Pilot Study Methodology**

C.1. Study Design

The study utilized wearable devices and daily diaries to assess the feasibility and acceptability of measuring sleep and activity of AGYW in slum communities in Kampala, Uganda over a period of 5 days.

C.2 Study Sites

This study was conducted in Kampala. Kampala is the capital city of Uganda, with a population of approximately 2 million people. Within Kampala there are 57 slum settlements across 5 divisions, housing over 50% of the city residents. UYDEL, a community-based organization in Kampala works with AGYW in slums in 3 of the 5 divisions: Kawempe division (Bwaise neighborhood), Makindye division (Makindye neighborhood) and Nakawa division (Banda neighborhood). This study was conducted at each of the three UYDEL sites of Banda, Bwaise and Makindye.

C.3 Study Participants

The study was carried out among young women aged 18 to 24 who lived within a 2 km radius of the Banda, Bwaise or Makindye UYDEL center. The study participants were those who were already enrolled in vocational skills training or waiting to start vocational skills training residing in slum areas.

Sixty participants were asked to participate in a voluntary five-day period of wearing a watch-like fitness tracker to record their sleep and activity space and completing pen-and-paper daily diaries concerning their activities and experiences. Participants attended a one-hour training workshop to provide them with information about the wearable and instructions for wearing the device and completing the daily diary. The training also involved aspects such as care of the wearables and research ethics relevant to the pilot study. After the five-day period, participants returned the devices and daily diaries to the UYDEL centers and received remuneration for their participation at that time.

C.4. Data Collection

The study utilized Garmin Vívoactive 3 wearables devices and daily diaries to obtain sleep and activity space data in this study. Surveys and focus groups were also conducted; these aspects of the pilot study are discussed elsewhere (Nielsen et al. 2024; Swahn et al*.* 2024).

*Garmin Vívoactive 3 Wearables*

The Garmin Vívoactive 3 used in our study is a wrist-worn wearable fitness tracker. The device contains an accelerometer (to measure movement), an optical photoplethysmography (PPG) sensor (to measure heart rate) and a global positioning system (GPS) receiver (to record location). Devices are water-resistant and are designed to be worn continuously. The Garmin Vívoactive 3 devices (without mobile phone connection) were used to collect a variety of behavioral indicators including information on sleep, physical activity, and travel behaviors. Sleep quality metrics included the total number of sleep hours, sleep wakefulness (e.g., number of night wakings, time spent awake), and sleep quality estimates (time asleep/time in bed or laying down, time in REM sleep, time in light sleep, and time in deep sleep). The Garmin watches also collected physical activity information (e.g., number of steps per day, location) which can be used to assess activity space and to determine exposure to neighborhood stressors.

*Daily Diaries*

Daily diary questions were designed to validate sleep disturbance data collected from the wearable and include the Patient-Reported Outcomes Measurement Information System (PROMIS) sleep disturbance scale. Additional questions were asked to validate physical activity and travel. The daily diaries were designed to take participants less than 15 minutes per day to complete.

1. **Data Analyses**

D.1. Sleep Data

Daily summaries of wearable data included sleep duration, wakefulness, REM sleep, deep sleep, and light sleep. Feasibility and acceptability of using the wearables for sleep data included examining data completeness and perceptions of wearable devices using survey data (Nielsen *et al.* 2024).

D.2. Activity Space Data

Data collected from the wearable devices was summarized into measures of physical activity (e.g., steps per day) and walking events/trips for comparison to self-reported travel. Feasibility and acceptability included examining data for the wearable devices (Nielsen *et al.* 2024).

During data analysis, location data was processed so that it no longer identified the specific locations participants visited (latitude, longitude), but only summary measures (such as time spent in pre-specified areas) and general distances between points (such as “3 miles from home”). Precise location coordinates (latitude, longitude) are not included in presentations or publications concerning study data.

D.3. Daily Diaries

Daily diaries were used to validate sleep and activity space data collected by the wearable devices. Daily diaries were also assessed for feasibility and acceptability by examining how many participants completed all five daily diary entries, the number of completed questions, and discrepancies documented for sleep times and wake times (Nielsen *et al.* 2024). Daily diary questions were assessed to have a United States first grade (equivalent to Ugandan primary one) reading level in English. Translations to Luganda were designed with a similar reading level, not to exceed Ugandan primary five.

1. **Participant Remuneration**

Participants received a total of 52,000 Ugandan Shillings (approximately $14) upon return of both the wearable device and daily diary booklet.

1. **Data Ownership, Sharing, and Dissemination**

Consent forms were completed by study participants and stored in a locked file cabinet for a minimum of five years.

All participants were assigned a unique identifier.

Location data was stored temporarily on Garmin’s servers subject to its Privacy and Data Sharing Policy (<https://www.garmin.com/en-US/privacy/global/>).

The research team makes all reasonable efforts to share findings of research with UYDEL, research participants, key stakeholders and communities where this research is conducted.

**References**

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