ABSTRACT

Title of Thesis:	SURVEY ON HEALTH DEVICE USE BY MTURK PARTICIPANTS
	Shankar Ramesh, Master on Science in Human-computer Interaction, 2018
Thesis Directed By:	Dr. Eun Kyoung Choe, College of Information Studies

Mechanical Turk (MTurk) is a crowd-sourcing platform provided by Amazon that helps in the distribution of micro-tasks among a user-base of thousands of registered participants. It has attracted many researchers due to its low cost and fast response time, and many task-participants due to easy and quick cash, and anonymity. Researchers have started using MTurk to implement innovative ideas for collecting datasets. One potential use of MTurk is to recruit participants in research involving the collection of health monitoring data. Little is known about the demographics of MTurk users who collect health monitoring data and their willingness to provide those data for research purposes. In this study, we aim to characterize the demographics and willingness of MTurk users to share data from health monitoring technologies for research. Findings from this work enable researchers to assess the appropriateness of MTurk as a source to recruit individuals willing to share personal health monitoring data.

SURVEY ON HEALTH DEVICE USE BY MTURK PARTICIPANTS

by

Shankar Ramesh

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Advisory Committee:
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Chapter 1: Introduction

1.1 Background and Motivation

1.1.1 Amazon Mechanical Turk

In the past few years, online surveys and crowdsourcing of micro-tasks have become widely-accepted sources for quick data. This can be seen from the growth in the number of participants registering for such services. One such online tool is Amazon's Mechanical Turk (MTurk®) [1]. Some of the most note-worthy reasons for this are its ease of use, quick response time, and low cost involved.

Tasks are designed in such a way that they can be easily interpreted by the workers. Workers are eligible to participate in a task if they meet the eligibility criteria set by its requester. Based on the quality of a response, the requester is entitled to either approve or disapprove payment to that particular worker.

Recently, many researchers from a variety of disciplines have turned to online sources for recruitment of study participants and data collection. This includes the use of social networking sites like Facebook [31], online newspapers advertisements, and other crowdsourcing websites like Amazon Mechanical Turk [32].

1.1.2 Health Monitoring Technologies

Researchers have started implementing innovative ideas for data collection using MTurk [33]. In a recent MTurk study [36] on identifying the lapses in design of health tracking tools that lead to users quitting its use, participants were recruited via an MTurk survey, after which they shared their FitBit® tracking data with the researchers using the FitBit Application Programming Interface. In another study [37], 30 MTurk workers who agreed to share their FitBit data with the researchers were routed to a third-party application called Fitabase [34], where they provided access to their FitBit data. In a similar way, using MTurk for creation of health monitoring data repository could solve the issue of lack of datasets, thereby proving to be a huge boost to potential research studies.

Health monitoring technologies such as wearable devices [8] and mobile applications [9] have been growing in popularity in recent times. Monitoring personal health and daily life activities have become a part of the lifestyle. Improving functionalities, better accuracy of data, and sleek design of wearable devices have made them a hugely popular choice among the masses [10].

This has led to an increase in interest among researchers and scientists in conducting research in this domain, aiming to provide users with better health insights. However, lack of comprehensive datasets and poor integration of data due to the diversity in their formatting have been the biggest roadblocks in this

endeavor [14]. This work explores MTurk as one potential resource that can be used to recruit users of health monitoring technologies to participate in research.

1.2 Research Objectives

This study aims to characterize MTurk workers' use of health monitoring technologies, and their willingness to provide their health monitoring data for research purposes. A survey was designed to capture demographic details of MTurk workers that use health monitoring technologies. The objectives of the survey were to:

(1) Characterize the types of health monitoring technologies MTurk workers use;
(2) Understand willingness of MTurk workers that use health monitoring technologies to share their data for research purposes;
(3) Characterize demographic details of MTurk that use health monitoring technologies; and
(4) Understand the motivations of MTurk workers to make their personal health monitoring data available for research.

1.3 Approach

To find answers to the above-stated questions, I conducted a survey-based study which aims at understanding the demographics of MTurk workers who use or have previously used Health monitoring technologies. This survey was designed such that it protects respondents' privacy and only collected anonymous data from them. It was divided into multiple sections, each of which dealt with a different aspect of the research objective.

The survey was published as a HIT (Human Intelligence Task) on MTurk. To make sure that the respondents understood the objective of this survey and provided honest answers, screening questions were asked before the start of the survey. Only workers qualifying based on all of these screening questions were eligible to participate further. These responses were analyzed to understand the potential of the Mechanical Turk service to act as a data source for health monitoring technology research.

1.4 Contributions

This thesis makes the following contributions:

(1) Establishes a baseline understanding of the demographics of MTurk workers who use health monitoring technologies.

(2) Enables more informed consideration of MTurk as a resource to recruit individuals that use health monitoring technologies into research studies.

(3) Highlights the potential to design new systems that enable MTurk workers to share their health monitoring data.

(4) Sheds light on the willingness and motivation of MTurk works who use health monitoring technologies to share their health monitoring data.

1.6 Organization

This thesis is organized into the following chapters. The first chapter provides an introduction to the problem, the background, the research objective, and the study

approach taken. A review of related work analyzing the demographics of MTurk workers and of health application users, and the use of Health monitoring technologies by MTurk workers is summarized in the second chapter. The third chapter covers a detailed description of the study procedure. The fourth chapter consists of a detailed analysis of the results. Finally, the last chapter considers these findings and discusses how they contribute to the research objective, and offers ideas for future research.

Chapter 2: Related Work

2.1 Overview

In this chapter, I have highlighted previous research investigating MTurk demographics, health monitoring technologies, and systems designed and developed to build upon the functionalities provided by MTurk. Since this is the first time that a study has been conducted to understand MTurk workers who use health monitoring technologies, literature that directly deals with this precise topic is currently unavailable. First, I describe previous studies conducted to understand the demographics and distribution of MTurk workers, followed by a review of demographic studies of users of health monitoring applications. This is followed by an overview of systems used to collect health monitoring data. Next, I highlight use of health monitoring technologies by people. Finally, I highlight other popular research systems that are developed to utilize features provided by MTurk.

2.2 Amazon Mechanical Turk and Micro-tasks

MTurk is an online crowdsourcing [2] service provided by Amazon which allows users to publish micro-tasks [3] online to a large pool of potential respondents. Examples of such tasks are surveys, audio transcriptions, video transcriptions, image labelling etc. The length of these tasks can vary from a few seconds to a few hours, depending on their nature. The compensation for such micro-tasks [5] could be as modest as $0.01 per task to a few hundred dollars.

The main reasons for using this service include: (1) need for a huge data set for analysis or (2) need for human interpretation of data [4]. Users who publish tasks for collection of responses are termed "Requesters," whereas those who participate in providing responses are termed "Workers." Also, the tasks that are published are called "Human Intelligence Tasks," or HITs.

According to claims made by MTurk, their service consists of more than 500,000 workers from 190 countries [6]. Even though there is no straight-forward way to check the validity of this statement, according to a recent study [7], it is estimated that, on average, there are 2,000 to 5,000 workers active at any given time. This translates to an equivalent of 10,000 to 25,000 full-time employees.

2.3 Demographic studies of MTurk workers

Survey-based studies [16, 17] have been conducted in the past to understand the change in demographics of MTurk workers. The most noteworthy outcome of these studies is the diversification of the participants with respect to their nationality. Even though the worker-base mainly consists of Americans, there has been a deepening interest and an increase in participation from India in recent years. This in turn, has resulted in an increase in the number of participants with a lower annual income, since the cost of living and corresponding income levels in the Indian subcontinent are relatively lower than that of US, Britain, Canada and many other nations. Rather than just a pastime, a significant number of participants treat MTurk as a daily source of income. As suggested by these studies, a majority of the MTurk workers are young, well-educated

females. It is understood that the number of well-educated workers is going up. Also, the number of male participants has been increasing with time.

2.4 Demographics of Health Application users

Previous studies on US mobile phone owners [21, 22] have shown that a huge number of American residents have downloaded and used mobile applications for health tracking, monitoring, and information. The health tracking applications could be either those that can be integrated with wearable health technologies, or those that make use of the inbuilt mobile phone sensors for their data source. Moreover, these numbers have gone up with time. While there has been constant growth in the number of users every year, many existing users have also been opting to discontinue due to many reasons like tedious manual data entry process, loss of interest, confusing app design, hidden costs, etc.

It is also observed in these studies of US mobile phone owners who have downloaded some health application at least once [22, 23] that nutrition and fitness applications are the most commonly used applications. Users of these applications tend to be younger, well-educated individuals with high incomes. The ratio of males to females is approximately equal to 1. These applications are used a lot on a daily basis by people of Latino/Hispanic ethnicity.

It is noted that even though there is a wide-spread interest in health monitoring technologies, there still is a lot of space for improvement. Among the participants who

have not used/stopped using health applications, most have shown interest in monitoring their health by setting personal goals, rather than gaining new information. It is expected that wearable health devices will be able to overcome the current roadblocks in providing users with a seamless experience of health monitoring.

2.5 Health Monitoring Technologies

There has been a major increase in awareness of health technology among people in recent times. A recent study shows that a majority of the population has a sound understanding of these technologies, irrespective of whether they use it on a daily basis or not [12]. Also, it is proven that these technologies motivate users immensely to achieve their goal of staying fit [13]. In 2016, the health monitoring technology industry was expected to hit a staggering $14 billion mark in revenue. Furthermore, it was estimated that this number will rise up to $34 billion in 2020, with 411 million wearable devices being sold [11].

It has been observed in past surveys [22, 23] that the majority of health monitoring technology users use it to monitor their health, track progress, and achieve their fitness goals. About half the participants said that they use these applications for tracking their health and fitness. This is followed by recording, managing, and analyzing their diet. Even though most devices/applications today provide functionalities to monitor sleep, body weight and many other physical and medical conditions, these are considered more as supplementary functions to fitness tracking. Other reasons include motivating

oneself, improving one's energy level, training for an event, tracking blood pressure, tracking blood sugar, etc.

2.6 Systems for the collection of health monitoring data

Open Humans [28], an online data donation platform, is a system that is designed for collection of personal data from users. This data could be anything from health tracking log to social media history. All that is needed to be done is creation of an account. Once the account is created, users can donate their data, which will be used by researchers for research and analysis purposes. These datasets will be available for use to anyone with an account.

Researchers can set up projects in Open Humans, and define the type of data required. One such project is Keeping Pace [29], run by Dr. Rumi Chunara [30]. The aim of this project is to collect data from health monitoring technologies. Currently, it accepts data from FitBit, Jawbone, Moves, Open Humans Healthkit Integration, and RunKeeper.

Fitabase [34] is a similar platform used to collect health monitoring data from all FitBit devices. Researchers and clinicians can setup projects/studies for which Fitabase will collect FitBit data of individual users. This data is then analyzed. However, unlike Open Humans, Fitabase is not an open-source platform and thus, not everyone can access the datasets. A recent study [35] on MTurk recruited 30 participants for data donation via this platform. They were first asked to complete a short online self-

administered questionnaire. After this, they donated their data for this particular research study via Fitabase.

Previous attempts have been made to collect health monitoring data from MTurk workers for research purposes [36, 37]. In the first study [36], a survey was released on MTurk for finding workers who have used FitBit. The workers were then asked to provide access to the researchers to their FitBit data. Then, they were presented with multiple visualizations of this data and were asked provide opinion on each of them in the survey. The second one [37] also released a survey on MTurk. Workers who own a FitBit device interested in the study were redirected to an external link, where they were queried for their willingness to share their FitBit data with the researchers. Upon agreeing to provide access to their data, they were re-routed to a third-party application, Fitabase, where they could share their data.

2.7 Systems based on MTurk

In order to make MTurk more research-friendly, third party web applications like psiTurk [24], TurkGate [25], and TurkPrime [26] have been developed recently. These applications provide greater flexibility and better control of the services provided by MTurk for researchers to design the whole study, and also to manage the participant crowd. These applications claim to provide better security for both requesters as well as workers.

In addition, TurkPrime provides an option to directly contact research experts for guidance. This feature helps the requesters (especially those who are new to survey-based studies) in getting professional feedback and help with designing the study and the survey. TurkPrime also allows requesters to conduct remote video studies. The user-group for these customizable studies could either be restricted to MTurk workers, or a wider audience-group that is registered with TurkPrime. TurkPrime can be considered as a complete learning and research experience application. Based on the outcomes of studies that are designed to understand the use of health monitoring technologies among the MTurk workers, a similar application for collection of health monitoring data could be developed.

While these approaches allow researchers to recruit a large pool of participants who use health monitoring technology, it is hard to know how representative these participants are because little is known about the general demographics of the platform users. In this thesis, I aim to address this gap.

Chapter 3: Study Method

3.1 Overview

To understand demographics and opinions of MTurk workers that use health monitoring technologies, we designed a survey and recruited current and previous health monitoring technology users. This survey was prepared using Qualtrics™, which was then published on MTurk for collecting responses. The survey consisted of multiple blocks, each of which covered an aspect of the study objective. A total of 1,000 unique responses were collected, out of which 935 were valid responses (refer to section 4.1) and these were used in the analysis.

Each participant was paid $0.40 for their responses. An automated random number generator was used to generate validation codes for respondents. Also, to make sure that the efficiency of the data does not decrease, respondents of all the previous batches were blocked from responding to the latest batch of HITs. The collected data was kept secure. It was ensured that the data collected did not reveal the identity of respondents.

3.2 Survey Design

An online survey was designed to collect the demographics of MTurk workers that use health monitoring technologies, the types and use of those technologies, and their wiliness to share data from those technologies for research. This survey was designed in Qualtrics and was published on MTurk for responses. The survey consisted of four main blocks, namely, the introduction block, the screening block, the question block,

and the end block. The survey structure and questions were revised multiple times so that it was minimalistic yet detailed. Each block is described in detail in the following sub-sections.

3.2.1 Introduction block

This block provided an overview of the study. Also, it provided the respondents with details about the time limit, compensation, risks, benefits, IRB approval and contact details of the investigators in case they felt the need for clarification of details. Respondents were also made aware of the fact that their participation in this survey was completely voluntary, and that they have the right to stop participating at any point of time. A final statement reading "Your completion of this survey will serve as your consent to be in this research study" served as proof for the respondents' consent to participate in this study.

3.2.2 Screening block

To make sure that the respondents understand the objective of this survey and that they provided honest answers, a screening block, was included in the survey. This block served two main purposes. Firstly, it tested the respondents for their attention to the task at hand and secondly, it tested their understanding of the subject of this survey.

These goals were achieved by providing them with a detailed description of the terms "Health monitoring technology," and "Health monitoring data," followed by two questions. Only respondents who answered both the questions correctly

were allowed to continue taking part in the survey. The first question checked their understanding of the term ‘heath monitoring technology.’ The second question asked them about the methods that they use the most to monitor their health. Only participants with appropriate answers to both these questions were allowed to continue further with the session.

Following are the definitions of ‘Health monitoring technology’ and ‘Health monitoring data’ used for this survey:

Health monitoring technology: A health monitoring technology is a wearable (e.g., wristband, clip-on), stand-alone device, or mobile app used for monitoring and tracking health and fitness-related metrics. Examples of the metrics include any of the following:

1. steps, distance walked, or run
2. food, calorie consumption, nutritional consumption
3. physiological functions like heartbeat, pulse rate, blood pressure
4. sleep duration, sleep quality

Health monitoring data: Health monitoring data are data produced by a health monitoring technology.

3.2.3 Question block

After passing the screening questions, respondents were taken to the question block. This block collects the required information from the respondents about

their habits and demographics. This block was further divided into five sub-blocks, each of which dealt with an aspect of the research objective.

The first sub-block asked about the general demographic background of the respondents. The second sub-block asked for their experience with MTurk, while the third one asked about their motivations for participating in MTurk. The fourth sub-block enquired about their experience using health monitoring technologies. It asked about each device respondents use, their purpose for using it, and the length of time that they have been using it. The final sub-block in this block asked about their interest in submitting their health monitoring data for research purposes, the frequency of donation, and the compensation expected for their participation.

3.3.4 End block

On successful completion of the survey, respondents were displayed with a short message of appreciation for their participation. They were also provided with a random, auto-generated validation code. This validation code had to be entered back on MTurk by them. This code helped in verifying the legitimacy of respondents and eliminating responses generated by spam and automated scripts.

3.3 Participants and Recruitment

A short description of the study along with a link to the survey was released on MTurk. Access to this study was limited to MTurk workers. Only adults, over the age of 18, were eligible for this study. MTurk workers who wished to participate in this study were first required to respond to screening questions. Only those with a positive response to these were allowed to participate further in the survey (refer to section 3.3.2).

Previous studies conducted to understand the demographics of MTurk workers [15, 16, 17] have all had approximately 1,000 participants, indicating that this is a reasonable sample size. This set of 1000 HITs was published in four batches. The first two batches were pilot batches, consisting of 20 HITs and 10 HITs respectively. The third batch consisted of 470 HITs, while the final batch consisted of 500 HITs. From a total of 1000 responses collected, 935 responses were found to be valid and were included for further analysis.

3.4 Procedure

The initial step in designing the survey was analyzing and drawing from previous MTurk demographic surveys. After this, the survey was divided into sections according to the objective of this study. Several revisions of the survey were conducted as it was crucial for it to be clear and to avoid being tedious and time-consuming for the respondents. Pilot tests were conducted to check the time required for completing the

survey. Once the survey was ready, approval from the institutional review board (IRB) of Johns Hopkins University and University of Maryland College Park was obtained.

Since this study aims to understand MTurk workers who have used health monitoring technology, no restrictions were imposed upon the user group that could participate. An initial batch of 20 HITs was published for pilot testing. Analyzing the results of this batch helped us to become aware of the need for random, automated verification codes for respondents. Having a different verification code for each user would help in mapping the responses of faulty/spam respondents to their MTurk worker ID, thereby enabling us to exclude their response. So, as shown in Figure 1, an automated verification code generator was set up in Qualtrics, using its random number generator [18].

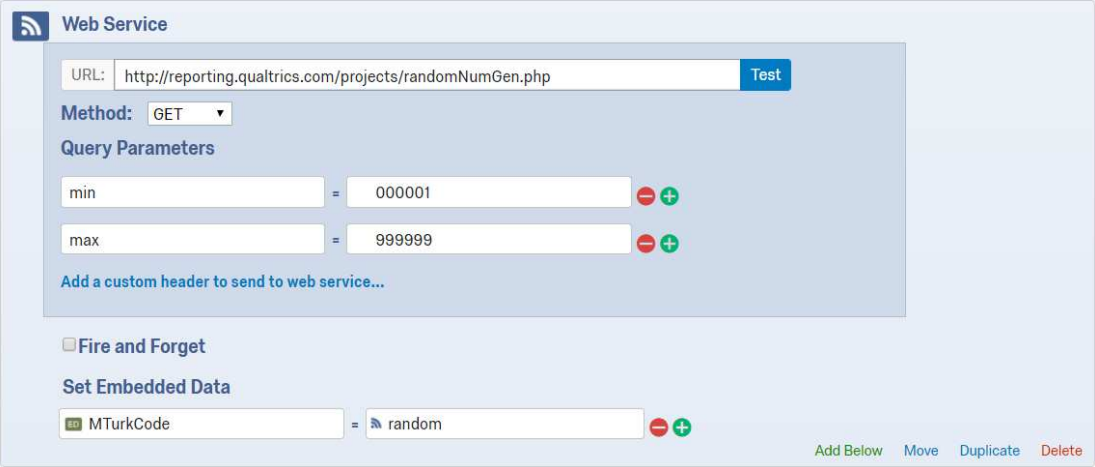

Figure 1 – Qualtrics random number generator

Before publishing a new batch of HITs, it was necessary to block the previous 20 respondents, since having multiple responses from same respondent would affect the

dataset negatively. MTurk provides a feature to easily block previous respondents from responding to a new batch of HITs [19]. Once this was done, a new batch of 10 HITs was published for pilot testing. After analyzing the responses for the first 2 test batches, two more batches, one of 470 HITs and the other of 500 HITs, were published, for a total of 1,000 HITs.

3.5 Data Security and Anonymity

Care had been taken while preparing the survey to refrain from ask for any data that could compromise the identity of respondents. All responses were completely anonymous. The survey responses were analyzed to understand the potential of the Mechanical Turk service to act as a data source for Health monitoring technology research. At no point in time during this process was direct contact made with the respondents.

Neither MTurk nor Qualtrics stores data that could be used to identify the respondents. Even though the MTurk response list stores their Worker IDs, it does not allow access to their profile. Figure 2 shows a worker's profile as seen by a requester. Also, any potential loss of confidentiality was minimized by storing the data on a password-protected computer. Access to the responses was limited to the investigators of this study.

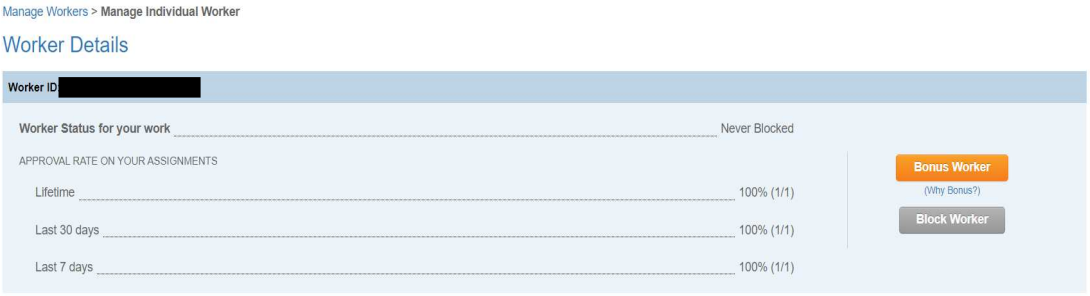

Figure 2 – Worker profile as seen by a requester

Chapter 4: Analysis

4.1Overview

A total of 935 responses were considered to be valid for further analysis. Responses that fell in at least one of the following categories were not included in the dataset used for analysis:

(1) Responses that failed the qualification question(s).

(2) Responses still in progress.

(3) Responses with more than one invalid/blank entry.

Responses with a single empty/invalid entry were assumed to be genuine errors and therefore, were considered for the analysis. This assumption was supported by the fact that all such responses required an appropriate time duration for completion. Based on the pilot tests that were conducted, a minimum threshold time was set and responses were included for analysis according to this time.

A number of biases may exist and thus were considered in our interpretation and discussion of the results:

(1) Date, day, and time of publication of the HITs.

(2) Location bias *(as stated in the literature review, the majority of MTurk workers are from America and India.)*

(3) Personal reservations *(about providing complete/correct information.)*

(4) Time constraint for a HIT.

(5) Compensation rate.

(6) Motivation/mood of the respondent [27]

4.2 Demographic Analysis

4.2.1 Nationality

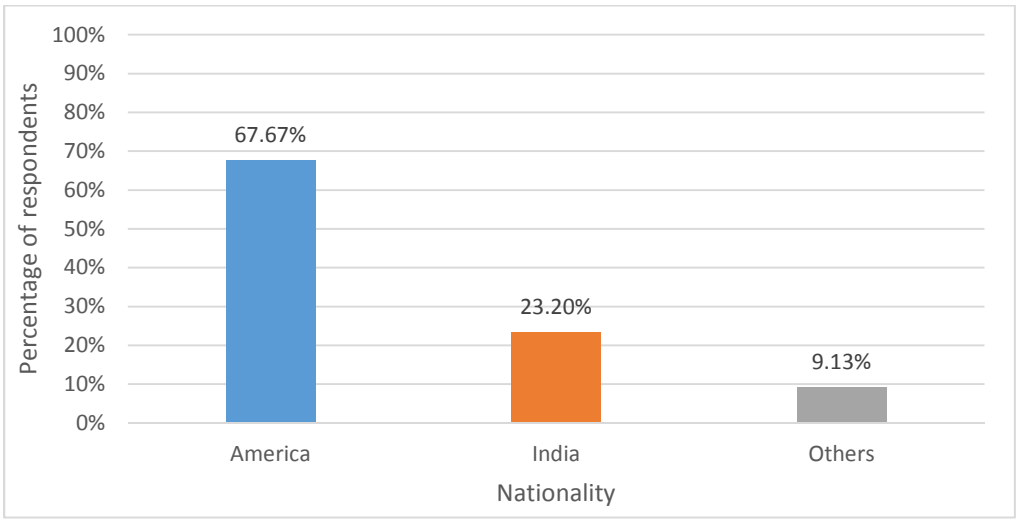

Figure 3 – Nationality of respondents

In total, 935 responses by participants from 34 different nations were recorded. Like the previous demographic surveys of MTurk workers [16, 17], a majority of the users were from America (i.e., North as well as South America). This was followed by a significant amount from India. Specifically, as shown in Figure 3, we have the following breakdown across nations: America - 67.67%, India - 23.20%, Others - 9.13% The list of other nations includes Australia, Bangladesh, Canada, China, Costa Rica, Croatia, Cuba, Dominican Republic,

Ecuador, France, Germany, Italy, Jamaica, Korea, Macedonia, Mexico, New Zealand, Nigeria, Nigeria, Pakistan, Peru, Philippines, Poland, Puerto Rico, Romania, Singapore, Spain, Sri Lanka, Taiwan, Tanzania, UK, Venezuela, and Vietnam. As reported by previous studies, participation from India has increased significantly since Amazon has allowed workers from India to receive payment in Indian Rupees [20].

4.2.2 Gender

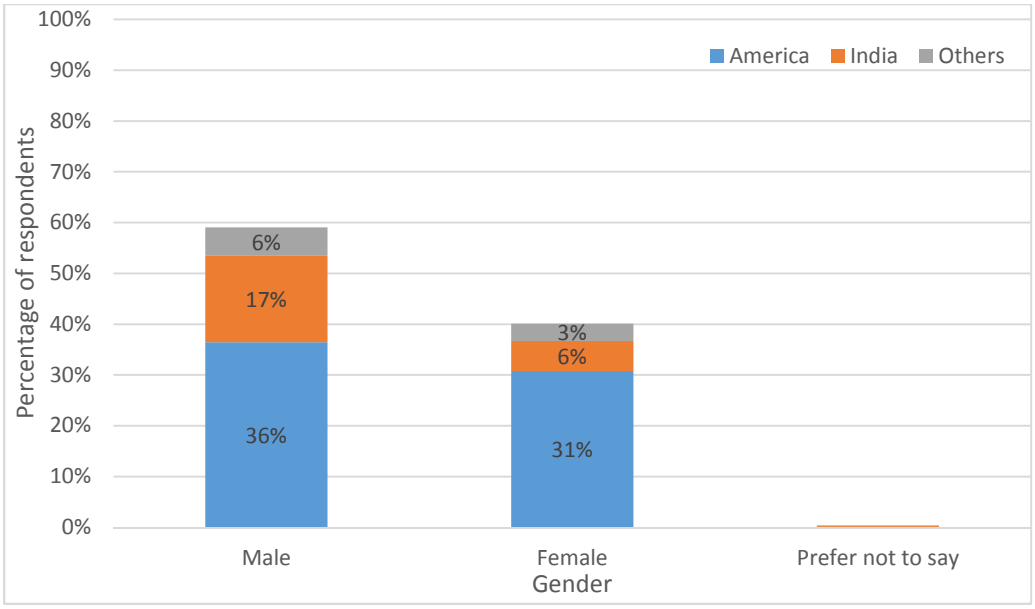

Figure 4 – Gender of respondents

Considerably more females (40.28%) than males (59.3%) responded to our sample, as shown in Figure 4.

Among the American workers, the difference in male participants (54.13%) and female participants (45.71%) is not very considerable. However, this situation is reversed for Indian workers, where the number of male participants is 76.61% and that of female participants is a just 25.46% of the total participants.

4.2.3 Age

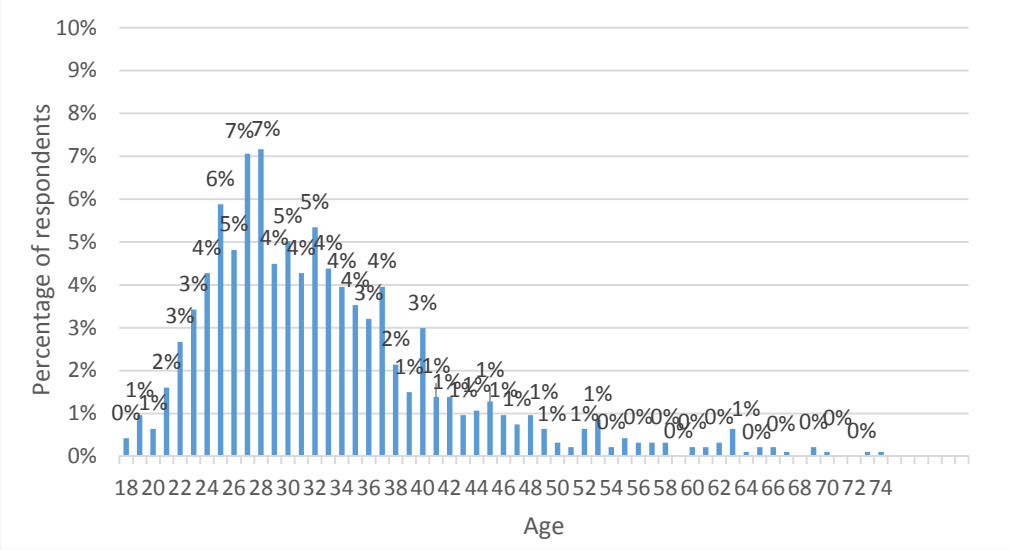

Figure 5 – Age of respondents

As seen from Figure 5, majority of the respondents are between 22 and 37 years old. This age group consists of almost three quarters (74%) of the sample.

4.2.4 Ethnicity

From Figure 6, it can be seen that a majority of the participants responded that they are either White or Asian/Pacific Islander. These are followed by Hispanics or Latinos, and Black or African Americans.

Although the data is skewed towards two of the ethnic groups, there still is a good mix of ethnic groups participating, forming a good set of potential data donors. Other than these, there were 4 respondents who belonged to mixed/more than 2 ethnic groups.

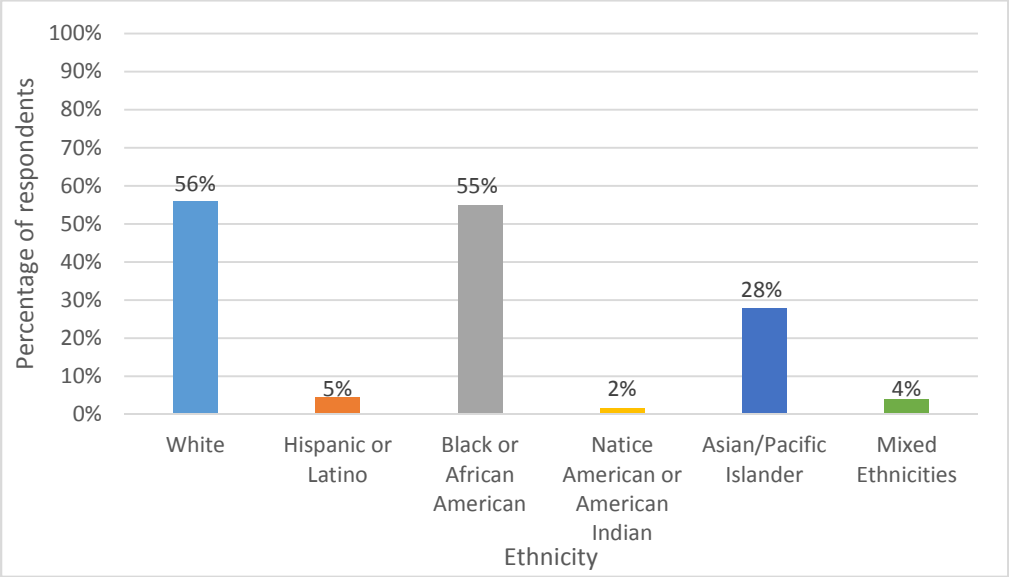

Figure 6- Ethnicity of respondents

4.2.5 Annual Income

As seen from Figure 7, the distribution of respondents by annual income is fairly consistent up to till $59,999. However, in America, the shape of this distribution follows that of a normal distribution. In contrast to this, the income level of Indian respondents is pretty low. For example, while 52.48% of the American participants have income in the range of $20,000 to $59,999, about

54.17% of the Indian participants earn less than $20,000 per annum. This is likely due to the following two reasons:

(1) Higher salary levels of the US

(2) Lower cost of living of the Indian sub-continent

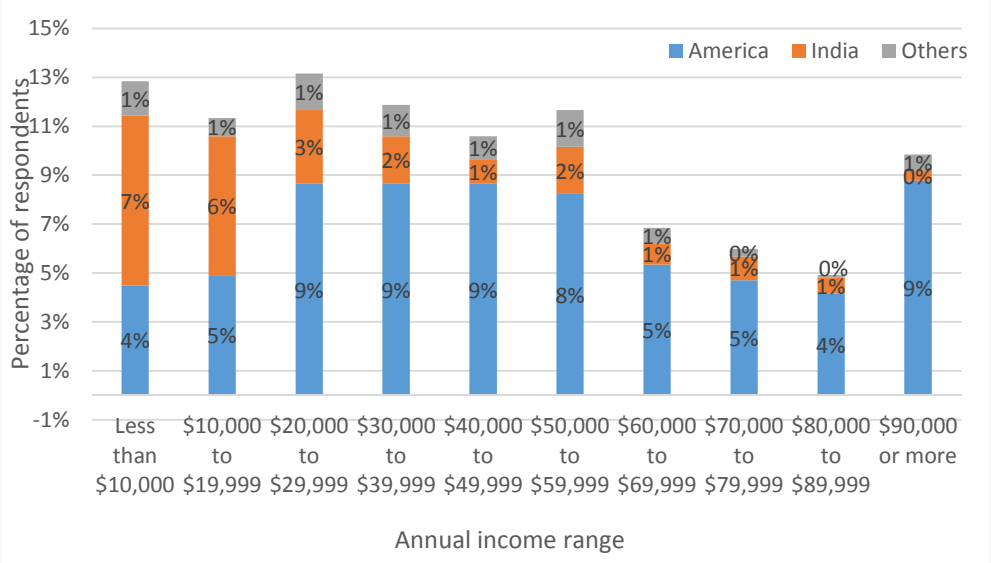

Figure 7 – Annual Income of respondents

4.2.6 Education

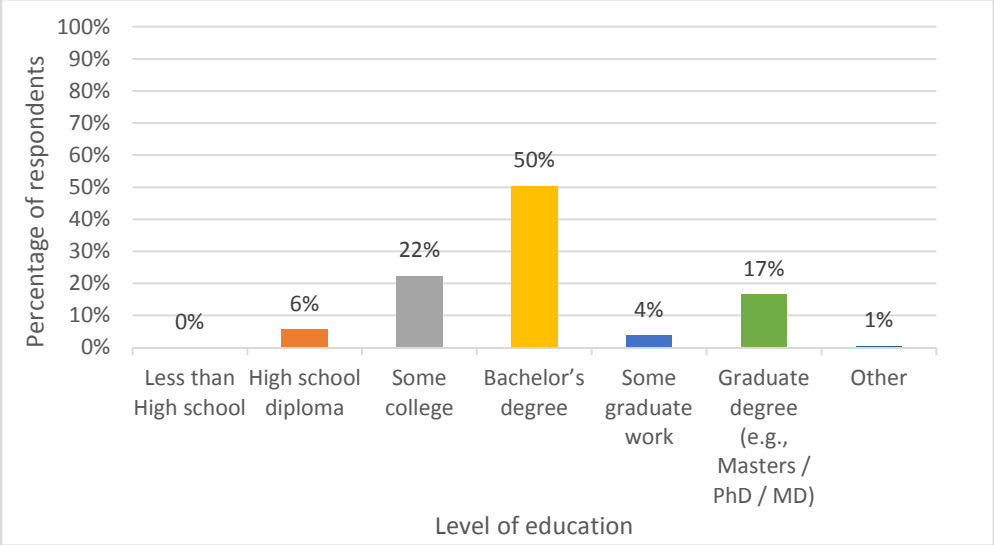

Figure 8 –Level of education of respondents

It can be seen from Figure 8 that almost all the respondents have completed at least college. Most of them (71.12%) have pursued education after college, out of which, a majority have (50.70%) have a Bachelor's degree. It is interesting to find that education distribution for each income level follows almost the same pattern as Figure 8, indicating a potential relationship between the two factors.

4.2.7 Implications of findings

(1) Health monitoring technologies are used by residents of large number of nations.

(2) As reported by the previous demographic studies of MTurk workers, there has been considerable participation from India.

(3) In contrast to previous demographic reports of MTurk workers, for our sample of MTurk workers using health monitoring technologies, participation of Males is higher than females.

(4) The majority of MTurk participants using health monitoring technologies are young (with an average age of 33.07), well-educated individuals. This could be due to the fact that newer generations are becoming more conscious and aware of the need for a healthy lifestyle and good fitness levels.

4.3 Experience with Mechanical Turk

4.3.1 Observations

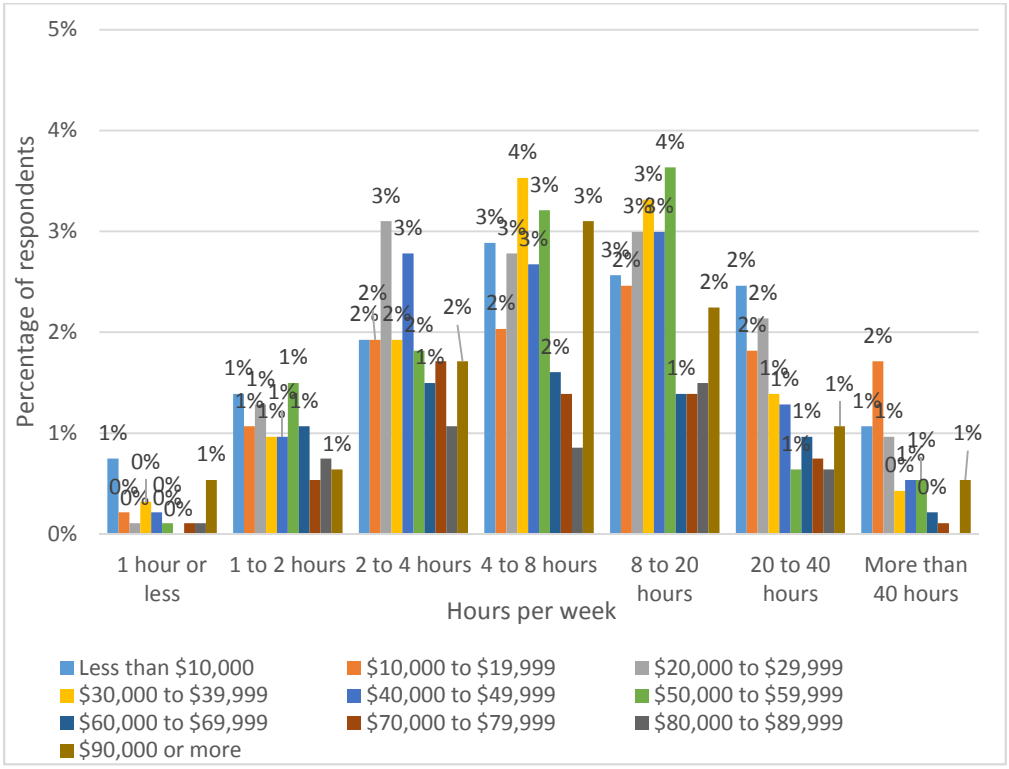

Figure 9 – Hours on MTurk per week based on annual income

Figure 9 shows the distribution of Experience of participants with MTurk based on their income level. Following are a few observations made about the nature of respondents:

Not so surprisingly, it can be seen that respondents who earn less than $30,000 per annum have the highest participation in MTurk, giving a hint of their dependency on MTurk for daily income. About half of those who participate for 20 to 40 hours per week earn less than $30,000. From the participants who spend more than 40 hours per week, 61.4% earn less than $30,000.

Interestingly, most groups with a high income (above $60,000) have a flat graph as compared to the other groups (less than $60,000) who have steeper curves. Also, about 50% of the participants report spending about 4 to 8 hours per week performing tasks on MTurk.

Looking at the top three education levels, most respondents with either a Bachelor's degree (67.51%), or some college degree (75.23%) or a Graduate degree (65.16%) acknowledge spending between 2 to 20 hours a week on MTurk. On analyzing the distribution based on the nationality of respondents, it can be seen that a large proportion of respondents from America (71.43%) participate for about 2 to 20 hours per week. In contrast, just 57.87% of Indians participate for the same amount of time.

4.3.2 Implications of findings

(1) Workers with lower annual income spend more time completing HITs on MTurk

4.4 Motivations for using Mechanical Turk

4.4.1 Observations

About 89.52% of the total respondents have indicated using MTurk either as their primary source of income, or secondary source of income, or as a source of extra cash. About 44.92% have said that they use it for earning extra cash whereas about 30.16% have said that they use it as their secondary source of income.

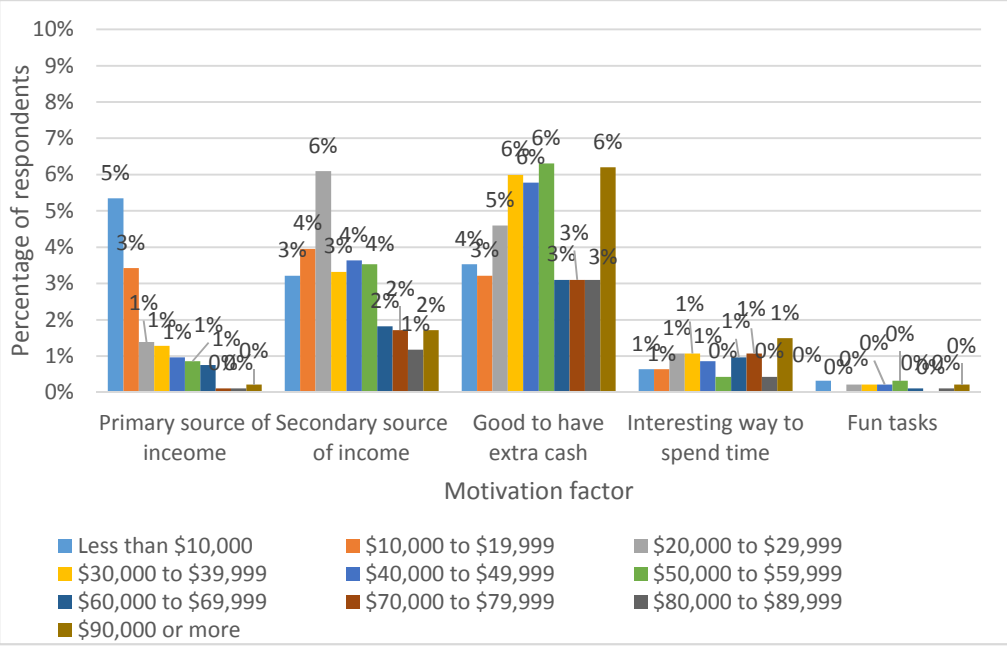

Figure 10 – Motivation for using MTurk based on annual income

It can be seen from Figure 10 that except for the groups that have an annual income of less than $30,000, the majority of MTurkers report using MTurk for extra cash. A majority of the respondents with income less than $10,000 per annum admit using MTurk as their primary source of income, while the majority of those who earn between $10,000 and $29,999 reported that MTurk is their secondary source of income.

Nearly two-thirds (65.57%) of those who earn less than $10,000 per annum reported using MTurk as a source of income. The corresponding numbers for respondents earning between $10,000 and $19,999 is 65.71% and for those earning between $20,000 and $29,999 is 60.87%. Looking at the group of respondents who have reported MTurk is their primary source of income, it is observed that a staggering 48.89% of them are Indians earning less than $10,000 per year.

4.4.2 Implications of findings

(1) A huge majority rely on MTurk as a source of income.
(2) Most participants from lower income groups consider MTurk as their primary/secondary source of income.

4.5 Use of Health Monitoring Technologies

4.5.1 Observations

From the data collected, it is observed that about 93.69% of the respondents had used some health monitoring technology in the past. Few of these participants had stopped using them during the time of survey. Also, about 85.88% of the respondents admitted to currently using some health monitoring technology during the time of this survey. Nearly 70% (69.52%) of the respondents have used these technologies over both the time periods.

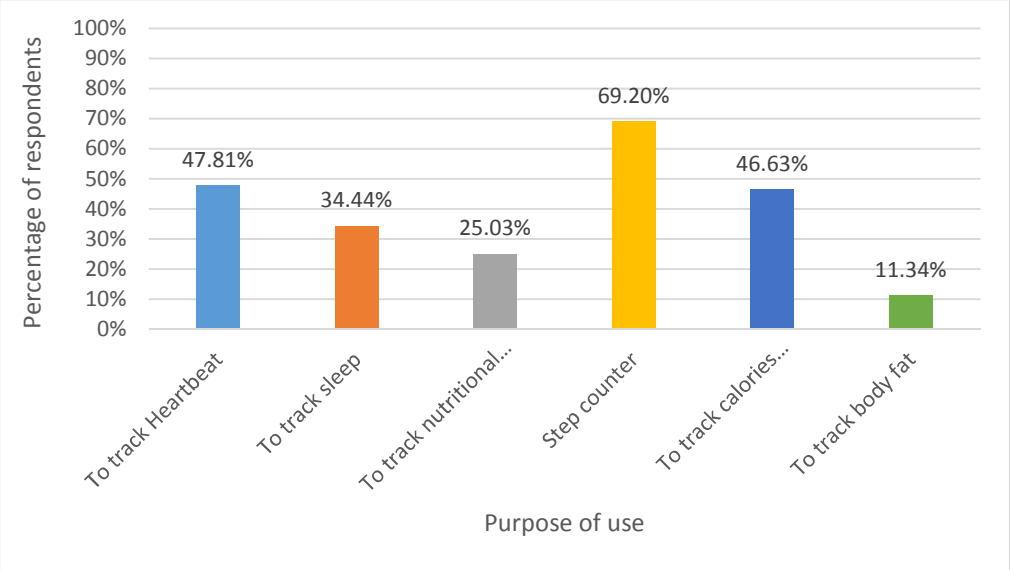

Figure 11 – Purpose of use of health monitoring technologies

Regarding their purpose for using health monitoring technologies, most respondents stated that they use it either as a step counter, or to track their heartbeat/pulse, or to track their daily calories burnt, as shown in Figure 11. A massive 69.20% of respondents have stated using these technologies to count

steps, while the respective numbers for tracking of heartbeat/pulse is 47.81% and for tracking calories consumed is 46.63%. The other options provided were to track sleep (34.44%), to track nutritional consumption (25.03%), and to track body fat (11.34%).

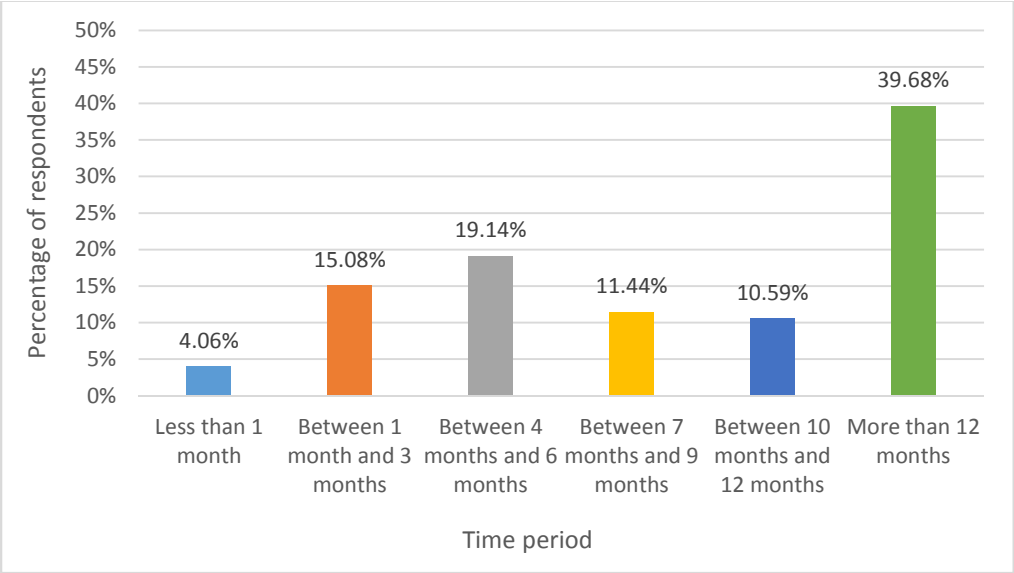

Figure 12 – Time of usage of health monitoring technologies

From Figure 12, it can be seen that about 4.06% of the total respondents have said that they have owned these technologies for less than a month. This rises to about 15.08% for those who have owned it for 1 to 3 months, and to 19.14% for those who have owned it for 4 to 6 months. 11.44% have used to for 7 to 9 months, while 10.59% have used it for 10 to 12 months. The rest, about 39.68%, have used these technologies for over a year.

4.5.2 Implications of findings

(1) A considerable number of survey respondents have discontinued using their health monitoring technologies after some time.

(2) Most survey respondents relied on these technologies to track factors relating to their physical fitness.

4.6 Most Used Health Monitoring Technologies

4.6.1 Observations

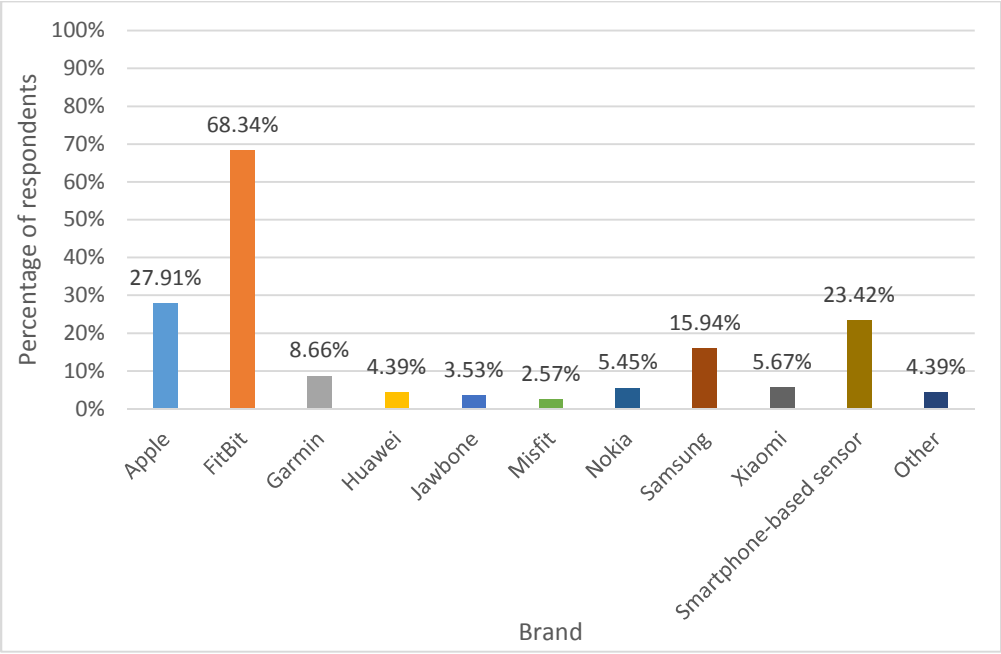

Figure 13 – Most used health monitoring technologies

It is observed that about 47.38% of the total respondents have used multiple health monitoring technologies. Among all the brands of technologies used by the respondents, the most popular ones seem to be FitBit, Apple, smartphone-

based sensors and Samsung, in that order (refer Figure 13). Out of all the available devices, the most-used devices are the 1st Generation Apple Watch and FitBit Flex.

Not so surprisingly, the most-used health monitoring technology is FitBit. As in Figure 13, a massive 68.34% of respondents have tried various FitBit products. Participants from 32 different nations out of the 34 respond using some FitBit product. About 71.90% of the total American participants and about 59.26% of the total Indian participants have used FitBit. These numbers afar exceed all competitors, giving a hint of its dominance in the market. The most popular FitBit model is FitBit Flex, which is used by 13.69% of the total respondents. This is followed by FitBit Ultra (9.20%), FitBit Charge 2 (8.24%), and FitBit Charge HR (7.81%). While majority of Flex (73.44%) and Charge 2 (87.01%) users have indicated using the device for counting steps, most Ultra users (58.14%) have mentioned using it for tracking their pulse/heartbeat.

The second most popular brand in this list is Apple. 31.66% of the total participants have used Apple devices. Even though respondents from 17 nations out of 34 have mentioned using Apple devices, the most important reason it is second in this list is its popularity in the America. About 68.92% of its total users are from America, which would be appropriate considering the huge popularity of Apple in America. As stated above, the 1st Generation Apple Watch is the most-used technology in this survey. 14.12% of the total

participants have used this device. 62.88% of these users have mentioned using it for counting steps. This is followed by 1st Generation - Watch Sport (4.28%), Series 1 (3.85%), and Series 2 – Watch Nike+ (3.53%).

18.50% of the respondents have used/are currently using Samsung devices, making it the third most popular brand of health monitoring technology in this study. This includes respondents from 21 different nations. 12.54% of the American respondents and 30.65% of the Indian respondents have used Samsung devices. The most popular devices are Galaxy Gear and Gear Fit, whose usage rates are about 6.10% and 4.92%, respectively. Surprisingly, even though Garmin is considered to be a leading brand in this domain due to its huge selection of devices, it stands fourth in this list, with about 8.66% participants using it. It's most popular devices are Vivosmart, Forerunner 235, and Vivofit 2.

Garmin is followed by Xiaomi (5.67%), Nokia (5.45%), Huawei (4.39), Jawbone (3.53), and Misfit (2.57%). To add to this, about 23.42% report using their Smartphone-based sensors on a regular basis, showing the growing popularity of these devices. 4.39% of respondents reported using various other devices, such as Nike, Pebble, etc.

4.6.2 Implications of findings

(1) Many survey respondents have tried multiple health monitoring technologies.
(2) Among survey respondents, FitBit is used more often than other health monitoring technologies.
(3) The most commonly used devices among survey respondents were FitBit Flex, 1st Generation Apple Watch, and FitBit Charge 2
(4) A majority of the survey respondents used health monitoring technologies to count steps.

4.7. Sharing of Health Monitoring Data

4.7.1 Observations

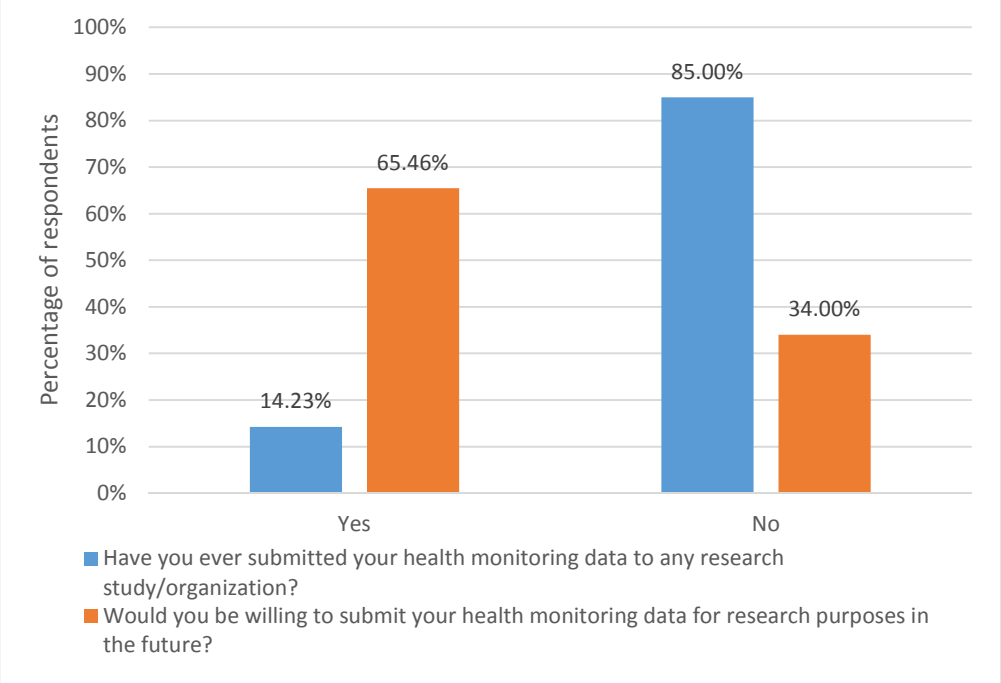

Figure 14- Willingness for data submission

From Figure 14, it can be seen that just 14.23% of the total respondents report having previously submitted their health monitoring data for research purposes. Also, 65.46% of the total respondents have stated that they would like to submit their data in the future. This gap in the number of participants who have previously submitted their data and those who are willing to submit it in the future could be attributed to the lack of knowledge about data submission.

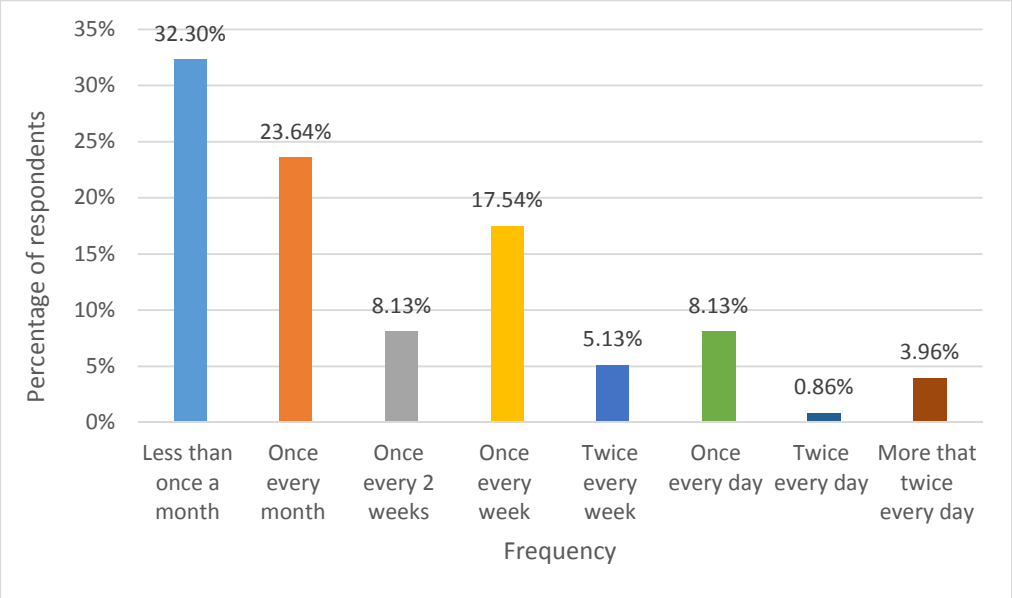

Figure 15 – Frequency of Data Submission

Figure 15 shows that the majority of respondents (32.30%) are willing to submit their health monitoring data less than once every month. This is followed by once every month (23.64%), and once every week (17.54%). Although participants wished to contribute their data infrequently, it will not affect the total amount of data submitted as most devices log data for an extended period of time.

When asked what they would expect in return for such data donation, about 73.16% of the total participants said that they would expect monetary compensation. Out of those who said that they would expect some other kind of compensation (1.93%), most of them either wanted a Gift Card or some kind of feedback on how to improve their health.

4.6.2 Implications of findings

(1) Most survey respondents have not shared their monitoring technology data for research but indicated a willingness to share those data. This finding illustrates that MTurk is a huge untapped resource for health monitoring technology data collection for research.

(2) Most expect monetary compensation to share their health monitoring technology data.

Chapter 5: Conclusion

This study aimed to investigate the demographics and opinions of Amazon Mechanical Turk workers that use health monitoring technologies, and their willingness to provide their health monitoring data for research purposes. A survey was designed to capture respondents' demographic details, as well as types and amount of health monitoring technology use. A total of 1,000 responses were collected and 935 responses that were considered valid were analyzed.

Respondents were both within and outside of the United States, with a majority being young and well-educated. A system like MTurk can have multiple benefits. Firstly, it can be a very efficient, cheap and quick system for crowdsourcing. As seen from the study, it can attract a very diverse group of workers, from different educational, social, and cultural backgrounds. Secondly, it can be advantageous to people with lower income, frequently acting as a primary source of income for these individuals to help them meet their daily needs.

In general, the HITs published on MTurk are tasks not limited to a particular nationality or a particular social or cultural group. Even though it usually can be completed by anyone, the nature of the study being conducted can restrict researchers to a particular group. In such cases, even with the functionalities provided, it is not possible to completely eliminate biased or faulty responses.

As stated previously, this thesis sets the stage for future work leveraging MTurk as a source of participants in research involving health monitoring technologies. It also provides a foundation of future studies aiming to understand willingness of MTurk workers to share their personal health monitoring technology data. Furthermore, there is potential to build upon the MTurk framework to enable researchers to draw from this resource to recruit individuals willing to contribute their personal health monitoring data for research purposes.

Appendices

Appendix A: Advertisement on Mechanical Turk

Survey on health device use by MTurk participants (3 to 5 minutes)

Description:

Have you ever used a Health monitoring technology? If yes, you are eligible for this survey.

This survey aims at understanding the demographics of Amazon Mechanical Turk participants who use Health monitoring technologies. It should only take about 3 to 5 minutes.

After completion of this survey, you will receive a Validation code that must be entered back on the Mechanical Turk webpage to claim your compensation. You will be awarded $0.40 for your time. Be assured that all answers provided will be strictly confidential. Your participation in this research is completely voluntary.

Go to the *(MTurk survey link)* to learn more about the study and participate. Note the **Validation code found at the end of the survey to claim your compensation.**

Appendix B: Web Survey

Thank you for agreeing to participate in this survey aimed at understanding the demographics of Mechanical Turk Workers. This is a joint initiative by Johns Hopkins University and University of Maryland College Park. This survey aims at understanding the demographics of Amazon Mechanical Turk workers who use Health monitoring technologies and their willingness to provide their Health monitoring data for research purposes.

The survey should only take about 3 to 5 minutes. After completion of this survey, you will receive a Validation code that must be entered back on the Mechanical Turk webpage to claim your compensation. You will be awarded $0.40 for your time. Responses will be analyzed for answers to the above-stated issues.

There are no known risks associated with participating in this study. Be assured that all answers provided will be strictly confidential. The survey asks for no information that could be used to reveal your identity. Any potential loss of confidentiality will be minimized by storing it on a password-protected computer.

There are no direct benefits to the participants, but the results could help in developing a better understanding of Mechanical Turk Workers who use Health monitoring technologies.

Your participation in this research is completely voluntary. You may choose not to

take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify.

If you decide to stop taking part in the study, if you have questions, concerns, or complaints, or if you need to report an injury related to the research, please contact the investigators:

Shankar Ramesh, University of Maryland College of Information Studies; shankar7@terpmail.umd.edu;

Dr. Casey Overby Taylor, Johns Hopkins School of Medicine; cot@jhu.edu;

Dr. Eun Kyoung Choe, University of Maryland College of Information Studies; choe@umd.edu

JHM eIRB: IRB00158371

UMD IRBNet: 1165377-1

Your completion of this survey will serve as your consent to be in this research study.

Block 1: Screening

Health monitoring technology: A health monitoring technology is a wearable (e.g., wristband, clip-on), stand-alone device, or mobile app used for monitoring and tracking health and fitness-related metrics. Examples of the metrics include any of the following:

1. steps, distance walked, or run
2. food, calorie consumption, nutritional consumption
3. physiological functions like heartbeat, pulse rate, blood pressure
4. sleep duration, sleep quality

Health monitoring data: Health monitoring data are data produced by a health monitoring technology.

Q1. According to the above description, which among the following could be termed as Health monitoring technologies?

Glucose meter

Activity Tracker (e.g., Fitbit)

Thermometer

Weighing Scale

Q2. Which of the following health monitoring methods do you use the MOST to keep track of changes?

Paper (notebook, journal etc.)

Computer-based software, like a spreadsheet

A website or online tool

A mobile application or a health monitoring device like Fitbit

A medical device, like a glucose meter

Or do you keep track just in your head?

Other _____

Block 2: Background and Demographics

Q3. What is your gender?

Male

Female

Prefer not to say

Q4. What is your Nationality?

_____

Q5. What is your age?

_____

Q6. Please specify your ethnicity (or Race)

White

Hispanic or Latino

Black or African American

Native American or American Indian

Asian / Pacific Islander

Other _____

Q7. Which of the following would be your annual income range?

Less than $10,000

$10,000 to $19,999

$20,000 to $29,999

$30,000 to $39,999

$40,000 to $49,999

$50,000 to $59,999

$60,000 to $69,999

$70,000 to $79,999

$80,000 to $89,999

$90,000 or more

Q8. Please select the highest level of education that you have completed

Less than High school

High school diploma

Some college

Bachelor's degree

Some graduate work

Graduate degree (e.g., Masters / PhD / MD)

Other _____

Block 3: Experience with Mechanical Turk

Q9. What is the average time spent on doing HITs per week?

1 hour or less

1 to 2 hours

2 to 4 hours

4 to 8 hours

8 to 20 hours

20 to 40 hours

More than 40 hours

Block 4: Motivation for using Mechanical Turk

Q10. Why do you complete tasks in Mechanical Turk?

Primary source of income

Secondary source of income

Good to have extra cash

Interesting way to spend time

Fun tasks

Block 5: Use of health monitoring technologies

Q11. Please answer by choosing the appropriate option for each statement

	Yes	No
I currently own a health monitoring technology		
I currently use a health monitoring technology		
I have owned a health monitoring technology in the past		
I have used a health monitoring technology in the past		

Q12. Please select all brands of health monitoring technologies that you use

Apple

Fitbit

Garmin

Huawei

Jawbone

Misfit

Nokia

Samsung

Xiaomi

Smartphone-based sensor

Other _____

(The following Questions 12.a to 12.i will be presented depending upon the response of Question 12.)

Q12.a. You indicated that you use Apple devices. Which model(s) do you use?

1st Generation - Watch

1st Generation - Watch Edition

1st Generation - Watch Hermes

1st Generation - Watch Sport

Series 1 - Watch

Series 2 - Watch

Series 2 - Watch Edition

Series 2 - Watch Hermes

Series 2 - Watch Nike+

Series 3 - Watch

Series 3 - Watch Edition

Series 3 - Watch Hermes

Series 3 - Watch Nike+

Apple - Other _____

Q12.b. You indicated that you use Fitbit devices. Which model(s) do you use?

Ultra

One

Zip

Flex

Force

Charge

Charge HR

Surge

Blaze

Alta

Alta HR

Charge 2

Flex 2

Ionic

Fitbit – Other _____

Q12.c. You indicated that you use Garmin devices. Which model(s) do you use?

Vivofit 1

Vivofit 2

Vivofit 3

Vivofit Jr. 1

Vivofit Jr. 2

Vivofit Jr. 3

Vivosmart

Vivosmart 2

Vivosmart 3

Vivosmart HR

Vivomove

Vivomove HR

Vivosport

Vivoki

Vivoactive

Vivoactive 2

Vivoactive 3

Vivoactive HR

Forerunner 25

Forerunner 35

Forerunner 235

Tactix Bravo

Fenix 5 series

Fenix Chronos

Descent Mk1

Garmin - Other _____

Q12.d. You indicated that you use Huawei devices. Which model(s) do you use?

Band

Band 2

Band 2 pro

Color band A2

Fit

Watch

Watch 2

Talkband B2

Talkband B3

Huawei - Other _____

Q12.e. You indicated that you use Jawbone devices. Which model(s) do you use?

Up

Up 2

Up 3

Up 4

Jawbone - Other _____

Q12.f. You indicated that you use Misfit devices. Which model(s) do you use?

Ray

Shine

Shine 2

Speedo shine

Flare

Swarovski Activity Crystal

Misfit - Other _____

Q12.g. You indicated that you use Nokia devices. Which model(s) do you use?

Whitings Go

Whitings Steel

Whitings Steel HR

Nokia - Other _____

Q12.h. You indicated that you use Samsung devices. Which model(s) do you use?

Galaxy Gear

Gear Fit

Gear 2

Gear 2 Neo

Gear Live

Gear S

Gear S2

Gear S3

Gear Fit 2

Gear Sport

Gear Fit 2 Pro

Samsung - Other _____

Q12.i. You indicated that you use Xiaomi devices. Which model(s) do you use?

Mi Band

Mi Band 2

Xiaomi - Other _____

Q13. Please select the purpose of your health monitoring technology use

To track Heartbeat/pulse

To track sleep

To track nutritional consumption

Step counter

To track calories consumed/burnt

To track body fat

Q14. How long have you been using/used the above-stated technologies for?

Less than 1 month

Between 1 month and 3 months

Between 4 months and 6 months

Between 7 months and 9 months

Between 10 months and 12 months

More than 12 months

Block 6: Comfort with sharing data from wearable devices with researchers

Q15. Have you ever submitted your health monitoring data to any research study/organization?

No

Yes

Q16. Would you be willing to submit your health monitoring data for research purposes in the future?

No

Yes

Q17. If yes, how frequently would you be willing to submit it?

Less than once a month

Once every month

Once every 2 weeks

Once every week

Twice every week

Once every day

Twice every day

More that twice every day

Q18. Would you be expecting a compensation?

No

Yes - Monetary compensation

Yes - Other form of compensation_____

Thank you for participating.

Your Validation Code is: **727272**

To receive payment for participating, enter this validation code in the Mechanical Turk window, and then click 'Submit".

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