

ORIGINAL RESEARCH

# Evaluation of a Population-Wide Mobile Health Physical Activity Program in 696 907 Adults in Singapore

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**BACKGROUND:** Evidence of scaled-up physical activity interventions is scarce. This study evaluates the uptake, engagement, and effectiveness of one such intervention program.

**METHODS AND RESULTS:** The program was open to individuals aged  $\geq 17$  years in Singapore. The main intervention components comprised device-based daily physical activity recording paired with step count goals and financial rewards. According to the different reward opportunities, we divided the evaluation period (August 2017 to June 2018) into the baseline monitoring phase, the main challenge phase, and the maintenance phase. Uptake was assessed by the number of individuals registered, and engagement by the step recording duration after registration. The effectiveness was defined as changes in mean daily step count from baseline to the main challenge phase and the maintenance phase. A total of 696 907 participants registered, including more Singapore citizens (versus noncitizens), women, and younger (aged 17–39 years) individuals. The evaluation of engagement and effectiveness included 421 388 (60.5%) participants who provided plausible characteristic information and step count data. The median duration of engagement was 74 (IQR, 14–149) days. Compared with the baseline of 7509 (SD, 3467) steps, mean daily step count increased by 1579 (95% CI, 1564–1594) steps during the main challenge phase and 934 (95% CI, 916–952) steps during the maintenance phase. Greater engagement and activity increase were found in participants who are citizens, women, aged  $\geq 40$  years, non-obese, and using separate wearables (versus smartphones).

**CONCLUSIONS:** Mobile health physical activity interventions can successfully reach a large population and be effective in increasing physical activity, despite declining program engagement over time.

**Key Words:** mobile health ■ physical activity ■ primary prevention ■ public health

Physical inactivity, a leading risk factor for noncommunicable diseases, has been prevalent globally with little improvement.<sup>1</sup> Effective physical activity interventions need to be scaled up urgently to increase population physical activity.<sup>1,2</sup> However, evidence of such scaled-up implementation has been limited, and the impact remains unclear.<sup>2,3</sup>

Recent advances in mobile and information technologies have provided unprecedented opportunities

to use mobile health (mHealth) approaches to scale up interventions, including the promotion of physical activity.<sup>4</sup> The systematic review of reviews for the US 2018 Physical Activity Guideline supports the use of mHealth to improve physical activity.<sup>5</sup> Another systematic review of randomized controlled trials and quasi-experimental studies further showed that mHealth interventions were more effective when they incorporated behavior change techniques, such as

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## CLINICAL PERSPECTIVE

### What Is New?

- This study presents a sustained scaled-up implementation of a mobile health physical activity intervention, which reached over 14% of the adult population in Singapore between 2017 and 2018.
- Based on the objectively measured daily step count, we found that the program engaged 60% of the participants for a median of 74 days and increased their daily steps by about 1500 steps during the main intervention period.

### What Are the Clinical Implications?

- The evaluation shows that increasing physical activity in a large real-world population is achievable by harnessing technology, behavior change techniques, and multisectoral collaborations.

## Nonstandard Abbreviations and Acronyms

<b>HPB</b>	Health Promotion Board Singapore
<b>mHealth</b>	mobile health
<b>NSC</b>	National Steps Challenge
<b>NSC3</b>	National Steps Challenge Season Three

self-monitoring, gamification, and financial incentives.<sup>6</sup> However, this evidence mostly originated from relatively small studies conducted under controlled settings with short follow-up periods.<sup>4–6</sup> Recently, several scaled-up mHealth physical activity interventions have emerged and demonstrated the potential of mHealth approaches in physical activity interventions<sup>2</sup> (Data S1, Figure S1, and Table S1). However, the effectiveness of these interventions was usually not evaluated or based on small and highly selective subsamples.<sup>7–13</sup> The 2 exceptions are the Carrot Rewards (N=35 014) and the Stepathlon study (N=69 219). Carrot Rewards found a small increase of 116 steps in daily step counts by the 12-week program in Canada.<sup>8</sup> The Stepathlon study, which included participants from around the world, on the contrary, observed a large self-reported increase of 3515 steps by the 100-day intervention.<sup>9</sup> The current evidence is thus scarce and inconsistent, and the impact of scaled-up mHealth physical activity interventions remains unclear.

The National Steps Challenge (NSC) is a nationwide physical activity program in Singapore that uses wearables, a smartphone application, and various behavior

change techniques.<sup>14</sup> It is implemented by the Health Promotion Board (HPB) under the Ministry of Health Singapore. With 1 event season each year since 2015, the NSC focuses on stepping activities in adults and collects extensive program data for evaluations. Multiple factors contributing to the successful implementation were discussed previously.<sup>14</sup> The present study aims to provide a comprehensive evaluation of the National Steps Challenge Season Three (NSC3). Specifically, our objectives are to evaluate the NSC3 uptake, engagement, and effectiveness in increasing physical activity.

## METHOD

Because of the sensitive nature of the data collected for this study, requests to access the data set from qualified researchers trained in human subject confidentiality protocols may be sent to the Health Promotion Board, Singapore at HPB\_Mailbox@hpb.gov.sg.

## Study Design and Participants

The NSC3 was a longitudinal intervention embedded in the national health promotion system of Singapore. Details of the NSC3 are available online.<sup>15</sup> Major NSC3 information channels included the Healthy365 App; 538 regular and 14 mega on-site roadshows conducted between September 21, 2017, and February 14, 2018, across Singapore; and mass-marketing campaigns through broadcasting, outdoor, and social media. The Healthy365 App is a mobile application developed by the HPB, with a supplementary kiosk version for non-smartphone users. It has been freely available on Google Play and the App Store in Singapore since 2015. Besides monitoring health behaviors, it serves as the main touchpoint for NSC and several other health promotion programs by the HPB. While providing weight and height is optional for using the Healthy365 App, users are required to report information on their birthday, sex, postal code, and the government-issued identification number, which can be used to differentiate Singapore citizens and noncitizens.

All Individuals in Singapore aged  $\geq 17$  years were eligible to register for NSC3. The noncitizens comprised permanent residents and other long-term visa holders in Singapore. The participation was free, and the registration was through the Healthy365 App since September 26, 2017, self-administered remotely or facilitated by HPB staffs at the roadshows. Singapore citizens and permanent residents were additionally eligible to collect 1 HPB-issued fitness tracker free of charge at the roadshows or at the HPB headquarters, if they registered for the NSC3 and had not received any HPB-issued tracker during previous NSC seasons.

Participants provided informed consent during registration and were allowed to withdraw from the NSC3 without a penalty at any point in time. Ethical approval for this study was obtained from the Institutional Review Board of the National University of Singapore.

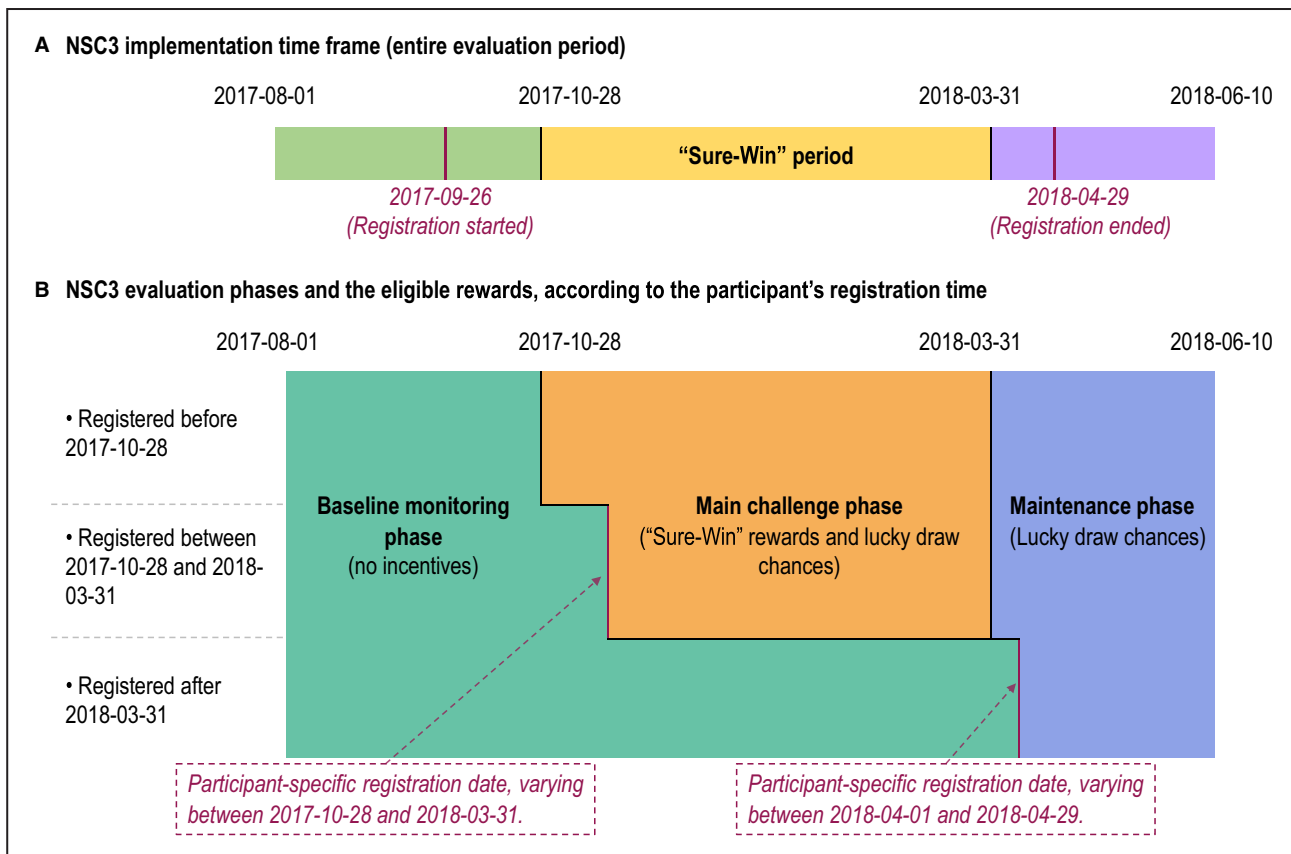
**Procedures**

The entire NSC3 evaluation period lasted from August 1, 2017, to June 10, 2018, encompassing the major event period: the Sure-Win period between October 28, 2017, and March 31, 2018 (Figure 1). The term “Sure-Win” refers to guaranteed rewards for physical activity achievements. Public education on physical activity and various subchallenges were delivered throughout the entire NSC3 period to raise awareness of active lifestyles and to keep participants engaged. The main NSC3 intervention components were daily physical activity monitoring paired with predefined step count goals and financial rewards for achieving these goals.

The Healthy365 App allowed NSC3 participants to record daily physical activity throughout the entire NSC3 period, even before registration. Participants with the Healthy365 App on their smartphones first measured

daily steps via their preferred wearables: HPB-issued trackers, self-purchased commercial wearables, or smartphones with built-in accelerometers (Data S2). The measured daily step count data had to subsequently be transferred to the Healthy365 App wirelessly, at least once every 7 days to avoid data loss. The transferred data were automatically uploaded to the HPB database server when the Healthy365 App connected to the Internet. Participants without smartphones or without the Healthy365 App on their smartphones could only measure daily steps using HPB-issued trackers and transfer their step count data using the “Sync-for-Friends” function of the Healthy365 App on other individuals’ smartphones. Alternatively, they could transfer the data via the HPB kiosks located at 34 outlets across Singapore. All participants were allowed to switch between supported wearables at any point in time.

Depending on participants’ registration dates and physical activity recording behaviors, each participant could experience up to 3 NSC3 phases for different durations: the baseline monitoring phase, the main challenge phase, and the maintenance phase (Figure 1). Characterized by the different incentive opportunities,



**Figure 1. Program implementation time frame and evaluation phases.**

**A**, NSC3 implementation time frame. **B**, Participant-specific NSC3 evaluation phases and the eligible rewards according to the participant’s registration time. Participants varied in time windows of the 3 NSC3 phases because of their different program registration time. NSC3 indicates National Steps Challenge Season 3.

the 3 phases were defined by the research team for evaluation purposes. The baseline monitoring phase included the days before the Sure-Win period if a participant registered for the NSC3 before October 28, 2017, or the days before a participant's registration date if the participant registered after October 28, 2017. During this phase, participants were not eligible to receive financial rewards. We defined the main challenge phase as the days of the Sure-Win period after participants registered. Two types of financial rewards, Sure-Win reward tiers and lucky draw chances, were available every day during this phase for achieving the predefined activity goals. The maintenance phase represented the days after participants registered for the NSC3 and after the Sure-Win period. During this phase, participants won lucky draw chances for achieving the predefined goals.

The 3 increasing daily step count goals were 5000 to 7499, 7500 to 9999 and 10 000+ steps. During the main challenge phase and the maintenance phase, participants earned 1, 2, and 3 lucky draw chance(s) each day they achieved the increasing step count goals, respectively. The lucky draw chances were for the NSC3 grand draw held on June 18, 2018, with prizes such as airline and cruise tickets. Each day during the main challenge phase, participants additionally earned 10, 25, and 40 Health-Points for achieving the increasing step count goals, respectively. Health-Points were accumulated for Sure-Win reward tiers. The first 750 accumulated Health-Points unlocked the first reward tier equivalent to S\$5. Additional 1500 Health-Points unlocked the second reward tier of S\$10. Afterwards, participants reached the next tier, up to the sixth tier (each equivalent to S\$5), with each additional 750 Health-Points. The reward tiers could be redeemed with a wide range of e-vouchers for lifestyle retailers, food and beverage outlets, and supermarkets.

## Outcomes and Statistical Analysis

We defined the program uptake as the individuals who registered for the NSC3. We summarized the daily and cumulative uptake over time and explored the uptake geographically by Singapore planning areas in absolute number and the percentage among the Singapore population (citizens and noncitizens) aged  $\geq 17$  years (Data S3 and Figure S2 and S3).

We considered the characteristics of a participant to be valid for further analyses if the participant provided plausible demographic and anthropometric information: identifiable nationality, sex, age  $> 17$  years, weight between 30 and 300 kg, and height between 101 and 220 cm. Characteristics of NSC3 participants derived from this information were compared with that of the entire Singapore population aged  $\geq 17$  years using chi-squared tests (Data S2).

The program engagement was characterized by the number of days a participant recorded valid daily steps following the registration. Daily step counts above 0 were considered to be valid. To obtain the percentage of engagement, we divided the duration of engagement by the participant-specific number of available NSC3 days. The available NSC3 days lasted from a participant's registration date to the end of the evaluation period on June 10, 2018. For participants who provided valid daily step count data, we compared the duration and percentage of engagement by participant characteristics using Kruskal-Wallis tests. A participant was considered to remain in the NSC3 until the last day the participant recorded steps. On each calendar date, we computed the percentages of registered participants who were engaged and who remained in the program.

We compared participants' mean daily step count by their characteristics using 1-way ANOVA. Activity difference by the day of the week and public holidays was explored through a linear mixed-effect model using mean daily step count on each calendar date as the dependent variable. NSC3 phase-specific random intercepts and independent correlation matrix were applied in the model (Data S4 and Table S2).

The effectiveness of the program was defined by changes in mean daily step count from the baseline monitoring phase to the main challenge phase and the maintenance phase. The changes were estimated via a main linear mixed-effect model with participant-specific random intercepts and unstructured within-participant correlation matrix. The dependent variable was the phase-specific mean daily step count, instead of the raw daily step count data. This was to reduce model imbalance because participants varied considerably in the number of days with step count data for each NSC3 phase. The model included only participants with at least 1 reliable phase-specific mean daily step count. The mean daily step count of an NSC3 phase was deemed to be reliable if the participant recorded steps for at least 4 days during the phase. The threshold of 4 days was based on a reliability analysis, reaching intraclass correlation coefficients of  $\geq 80\%$ .<sup>16</sup> Sensitivity analyses with thresholds ranging from 1 to 30 days as well as the complete-case analyses can be found in Tables S5 and S6. The indicator of NSC3 phases served as the independent variable of interest, which was included as a predictor in the linear mixed-effect model applied to all participants. The model also included 8 participant characteristic variables as fixed factors: participant's nationality, sex, age, body mass index (BMI), registration for the previous NSC season, NSC3 registration time, wearable used, and numeric duration of engagement.

To investigate whether the program effectiveness differed by participant characteristics, subgroup analyses



were conducted. Participants were stratified into subgroups by each of the above-mentioned 8 characteristic variables, including the duration of engagement categorized according to quartiles. A separate linear mixed-effect model was fitted for each subgroup using the same list of fixed factors as the model applied to all participants, except that it excluded the variable used to generate the subgroup.

We performed all the analyses in R (version 3.6.1), and used package “nlme” (version 3.1–141) for the linear mixed-effect models.

## RESULTS

A total of 696 907 participants registered for the NSC3, and 113 withdrew (Figure 2); 539 296 (77.4%) participants provided plausible demographic and anthropometric information; and 421 388 (60.5%) participants further recorded valid daily steps and were included in the evaluation of program engagement and effectiveness.

Uptake of the NSC3 started from September 26, 2017, and continued to increase until April 29, 2018, with major peaks coinciding with NSC3 mega roadshows. Thirty-three percent of the participants registered within the first month and 78% within the first 2 months (Figure 3). Geographically, participants were distributed across all residential areas in Singapore. A higher uptake in absolute numbers was observed in more densely populated areas, but we observed no clear geographical pattern in the percentage of uptake (Data S3 and Figure S2 and S3). Compared with the Singapore population, the NSC3 reached greater proportions of participants who were citizens, women, younger (aged 17–39 years), and non-obese and non-underweight (BMI 18.5 to <27.5 kg/m<sup>2</sup>), whereas participants who were noncitizens and men, older, and obese were underrepresented (Table 1).

As part of the NSC3, 40.1 million participant-days of step count data were recorded, 91.6% of which occurred after participants registered for the NSC3. The median duration of engagement was 74 (IQR, 14–149) days, accounting for 36% (IQR, 7%–68%) of the available NSC3 days (Table 2). Temporally, the percentage of registered participants who remained in the NSC3 on each date declined steadily over time. With intermittent drops on weekends and public holidays, the percentage of registered participants who were engaged on each date followed a U-shaped curve before the Sure-Win period and decreased steadily afterwards (Figure 4A).

Both duration of engagement and mean daily step count level were significantly higher in participants who were citizens, older (≥40 years), non-obese (BMI, <27.5 kg/m<sup>2</sup>), and who joined previous NSC seasons,

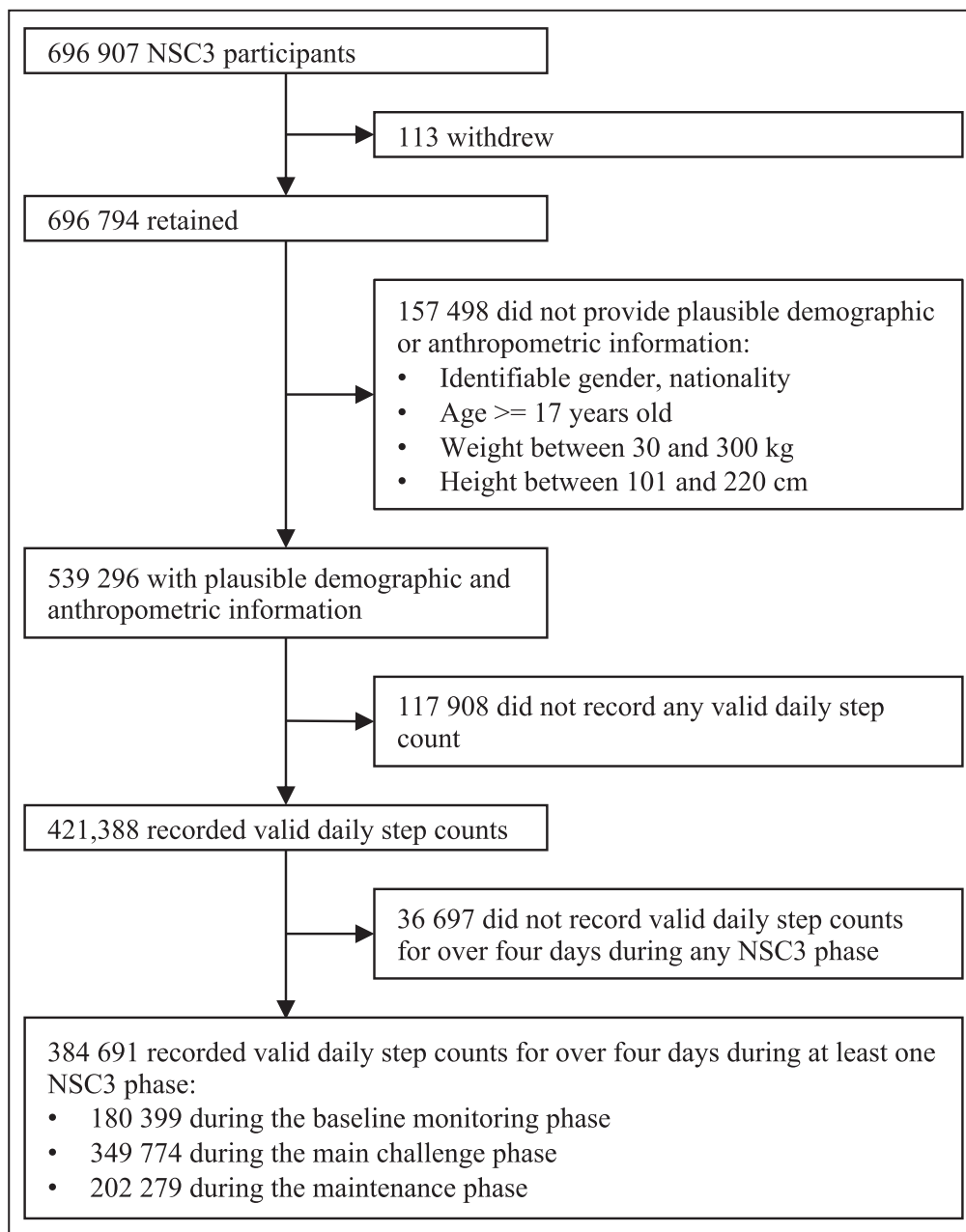
registered for the NSC3 earlier, and did not solely use smartphone-based wearables (Table 2). Male participants had shorter engagement, but a higher mean daily step count level. Across the NSC3 phases, daily step counts were lower on Sundays by 616 steps and public holidays by 789 steps (Figure 4B).

After adjustment for potential confounders, mean daily step count was 1579 (95% CI, 1564–1594) steps greater during the main challenge phase and 934 (95% CI, 916–952) steps greater during the maintenance phase than the level during the baseline monitoring phase (Table 3). These increases were robust in sensitivity analyses (Tables S5 through S7). Subgroup analysis revealed greater increases among citizens and noncitizens, women, the older (≥40 years), non-obese (BMI <27.5 kg/m<sup>2</sup>) participants, and those who were engaged longer and who did not solely use smartphone-based wearables.

## DISCUSSION

The NSC represents a sustained and scaled-up mHealth physical activity intervention embedded in the national health promotion system of Singapore. The large-scale program data, including objectively measured daily physical activity, provided a unique opportunity for in-depth evaluations. This evaluation of the NSC3 included all the 696 907 NSC3 participants. Sixty percent of them actively participated and were engaged for a median of 74 days. Compared to baseline, the mean daily step count increased by about 1500 steps during the main challenge phase and remained about 900 steps higher during the maintenance phase. To our knowledge, this study is the largest evaluation of an mHealth physical activity intervention.<sup>2,7–13</sup>

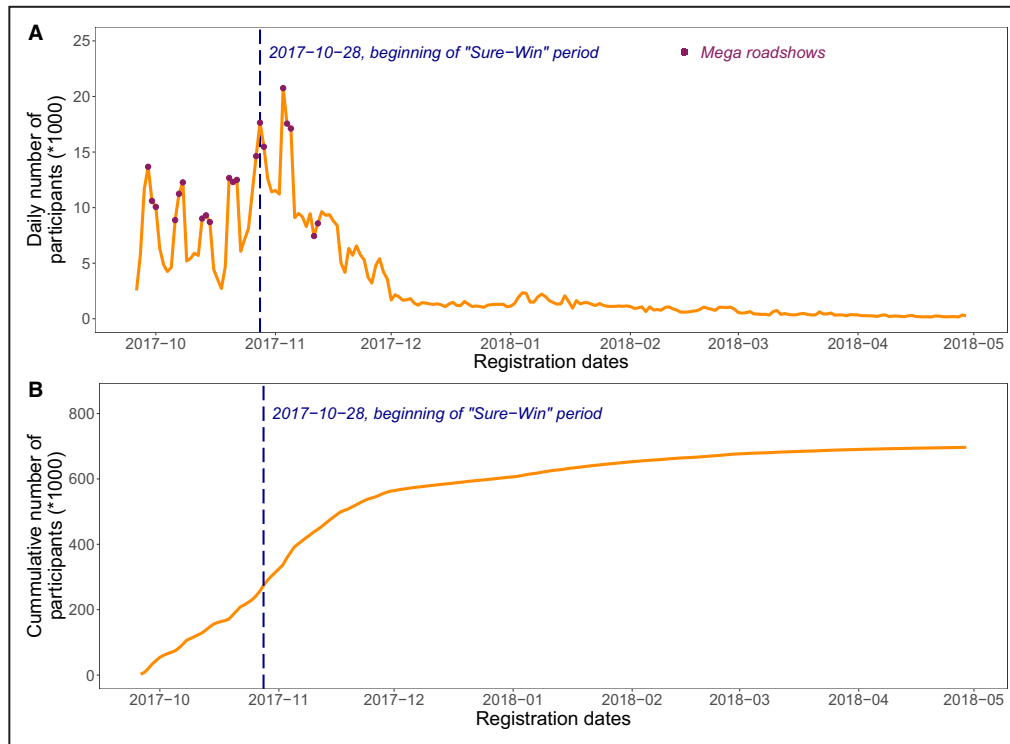
In 7 months, the NSC3 attracted more than 14% of the adult population in Singapore, over three-quarters of whom registered within the first 2 months. The participants presented diverse characteristics and were spatially distributed across the entire country. A substantial proportion of the participants belonged to subpopulations with elevated risks of physical inactivity, such as those aged >60 years or overweight.<sup>17</sup> The considerable and rapid reach of the NSC3 is likely attributable to various factors, including the focus on simple stepping activities, attractive incentives (eg, free fitness trackers, and Sure-Win rewards), versatile activity recording modes, and widespread on-site roadshows and public education.<sup>14</sup> According to our literature review, previous evaluations of mHealth physical activity interventions were substantially smaller and reached <70 000 participants.<sup>7–13,18</sup> Meanwhile, several other large-scale mHealth studies have emerged, along with many commercial smartphone applications.<sup>19–21</sup> However,



**Figure 2. Participant flowchart.**  
NSC3 indicates National Steps Challenge Season 3.

these studies and applications usually pursued different objectives and did not implement or evaluate physical activity interventions. The Apple Heart Study, for instance, assessed the ability of a smartwatch application to identify atrial fibrillation using pulse rate data from >400 000 participants.<sup>19</sup> Another study illustrated worldwide physical activity inequality using smartphone-based physical activity data from >700 000 people.<sup>20</sup> Together, our evaluation of the NSC3 and these studies and programs support the potential and feasibility of using mHealth approaches for large-scale real-world investigations.

Our evaluation illustrates that >60% of NSC3 participants were engaged, with a median of 74 days of the 223 program days. Engagement of other scaled-up mHealth physical activity interventions was quantified sporadically and heterogeneously, generally appearing lower than in the NSC3.<sup>7-13,18</sup> For instance, the 10 000 Steps Australia program found an average of 31 days of engagement during the 190 program days among the 17 000 participants who recorded step counts between July 2013 and April 2014.<sup>18</sup> Despite the comparatively long engagement observed in the NSC3, a substantial decline was observed over time, with less



**Figure 3. Daily and cumulative NSC3 uptake over time from September 26, 2017, to April 29, 2018 (N=696 907).**

NSC3 indicates National Steps Challenge Season 3.

than a third of participants recording activity by the end of the Sure-Win period. However, this finding is consistent with most mHealth interventions.<sup>6</sup> Some smaller mHealth randomized controlled trials, on the other hand, demonstrated greater engagement than the NSC3.<sup>22-24</sup> An important example is the TRIPPA (Trial of Economic Incentives to Promote Physical Activity) trial, an mHealth study to increase physical activity in Singapore adults.<sup>22</sup> About 70% of the 396 individuals, who received wearables and financial incentives, continued recording physical activity by the end of the 6-month intervention period. However, the percentage dropped rapidly to only 10% by the end of the 6-month follow-up. The higher financial incentives during the TRIPPA intervention, averaging around S\$470 (versus maximum S\$30 in NSC3), may partly explain the greater engagement.<sup>22</sup>

We identified several participant characteristics and patterns associated with greater engagement. Such knowledge has been scarce for mHealth approaches, especially for scaled-up programs.<sup>25</sup> Before our evaluation, an analysis of 100 000 participants from 8 studies between 2014 and 2019 was the largest investigation on indicators of higher mHealth engagement using individual-level data.<sup>25</sup> The study found clinical referral, monetary benefit, older age, and disease condition as key drivers. Our evaluation revealed additional positive

correlates of engagement: female sex, non-obesity, previous program registration, early registration, and usage of separate wearables (versus smartphones) for activity recording. The NSC3 also identified lower engagement on weekends and public holidays. Most factors positively related to NSC3 engagement were also associated with higher activity levels, except for male sex, which was associated with greater step count levels despite lower engagement. While these findings have potential to inform future strategies to increase engagement, mHealth interventions such as the NSC may not need a full-time engagement to achieve the desired behavior change.<sup>22,26</sup>

A recent systematic review of randomized controlled mHealth trials found that wearables and financial incentives together increased the mean daily step count in adults by 607 steps during the incentive period and 513 steps during the postincentive period.<sup>27</sup> The TRIPPA trial, which also targeted adults in Singapore, showed that wearables plus cash incentives improved daily step counts by 1000 and 500 steps at the end of the incentive and follow-up period, respectively.<sup>22</sup> Another recent systematic review of interventions using step count monitors (with or without financial incentives) in community-dwelling adults reported increased physical activity by 1126 steps/day at  $\leq 4$  months, 1050 steps/day at 6 months, and 464

**Table 1. NSC3 Participant Characteristics (N=539 296) Compared With the Singapore Population (N=4 845 000 as of June 2018)**

Characteristics	NSC3 participants, n (%)	Singapore population aged ≥17 y, %
Nationality		
Singapore citizen	349 259 (64.8)	59.1
Noncitizen	190 037 (35.2)	40.9
Sex		
Female	313 559 (58.1)	47.5
Male	225 737 (41.9)	52.5
Age, y		
17–39	270 241 (50.1)	39.4
40–59	207 871 (38.5)	38.7
60–79	58 490 (10.8)	19.4
≥80	2694 (0.5)	2.5
Body mass index, kg/m <sup>2</sup>		
<18.5	35 298 (6.5)	6.4
18.5 to <23	224 905 (41.7)	38.3
23 to <27.5	188 251 (34.9)	32.3
≥27.5	90 842 (16.8)	23.0
Registration for previous NSC season		
No	363 423 (67.4)	...
Yes	175 873 (32.6)	
NSC3 registration time		
Before Sure-Win period	196 832 (36.5)	...
Within 30 d since Sure-Win period began	215 571 (40.0)	
>30 d after Sure-Win period began	126 893 (23.5)	
Wearables		
HPB-issued	159 730 (29.6)	...
Phone-based	129 402 (24.0)	
Commercial	26 077 (4.8)	
>1 wearable type	106 179 (19.7)	
Not applicable*	117 908 (21.9)	

Comparisons of participant characteristics with the Singapore population using chi-squared tests: all  $P < 0.001$ . HPB indicates Health Promotion Board Singapore; NSC, National Steps Challenge; and NSC3, NSC Season 3.

\*No wearable information was available for participants who did not record any valid daily step.

steps/day at 1 year.<sup>28</sup> Our evaluation suggests that the NSC3 yielded larger increases in daily step counts. The larger increase may, in part, be attributable to other behavior change techniques in this multicomponent intervention, such as incremental step count goals, activity feedback, gamification with Health-Point tokens, and physical activity education.<sup>6</sup> It thereby indicates that the effectiveness of mHealth physical activity interventions can be retained in large real-world settings if they are carefully scaled-up. In the NSC3, greater increases in step counts were particularly apparent

among participants of older age, who used separate wearables (versus smartphones), and who had longer engagement. These findings are consistent with the above-mentioned systematic review of randomized controlled trials.<sup>27</sup> The present evaluation further found that citizens and women increased their physical activity more substantially. In addition, subgroups with higher baseline activity levels generally observed greater increases, except for men, participants with previous program registration, and participants using self-purchased fitness trackers.

Longitudinal studies have repeatedly demonstrated that higher daily step counts are associated with reductions in all-cause mortality, cardiovascular diseases, and type 2 diabetes.<sup>29–33</sup> For instance, in prospective cohort studies, every 1000-steps-per-day increment was associated with 6% lower mortality among Australians and 14% lower mortality among Britons.<sup>30</sup> Similarly, randomized controlled trials illustrated that increases in daily step counts comparable to or less than those observed in the NSC3 resulted in significantly improved health outcomes.<sup>34–36</sup> The increases in daily step counts observed in the NSC3 could therefore lead to substantial individual and population benefits.

Multiple factors and resources have contributed to the NSC3's large-scale implementation. First, the program adopted extensive multisectoral partnerships led by Singapore's governmental HPB, including collaborations with academic institutes, technology and manufacturing industries, retail establishments, and other governmental and community organizations.<sup>14</sup> This is consistent with existing evidence that partnerships beyond the health sector and political support are key factors for successful scaling up of physical activity interventions.<sup>2</sup> Embedded in the country's broad systematic health promotion framework, the NSC3 was able to synergize with various other programs and benefited from sharing major health promotion resources and infrastructures with them.<sup>14</sup> In addition, the NSC3 tailored the design and implementation of its multibehavioral intervention components by integrating the local practice-based health promotion experience with scientific research evidence.<sup>14</sup> While these features and the practice-based nature are integral for the scaled-up implementation of the NSC3, it is worth acknowledging that many of the implementation aspects were not research driven, which created challenges for the scientific evaluation. For instance, considering the complexity of this mHealth program, we are unable to determine specific effects of individual intervention components and their detailed interactions because no dedicated efforts were made to collect relevant data.

Despite the novelty and strengths of this evaluation, several important limitations should be acknowledged. First, the NSC3 was a population-wide health



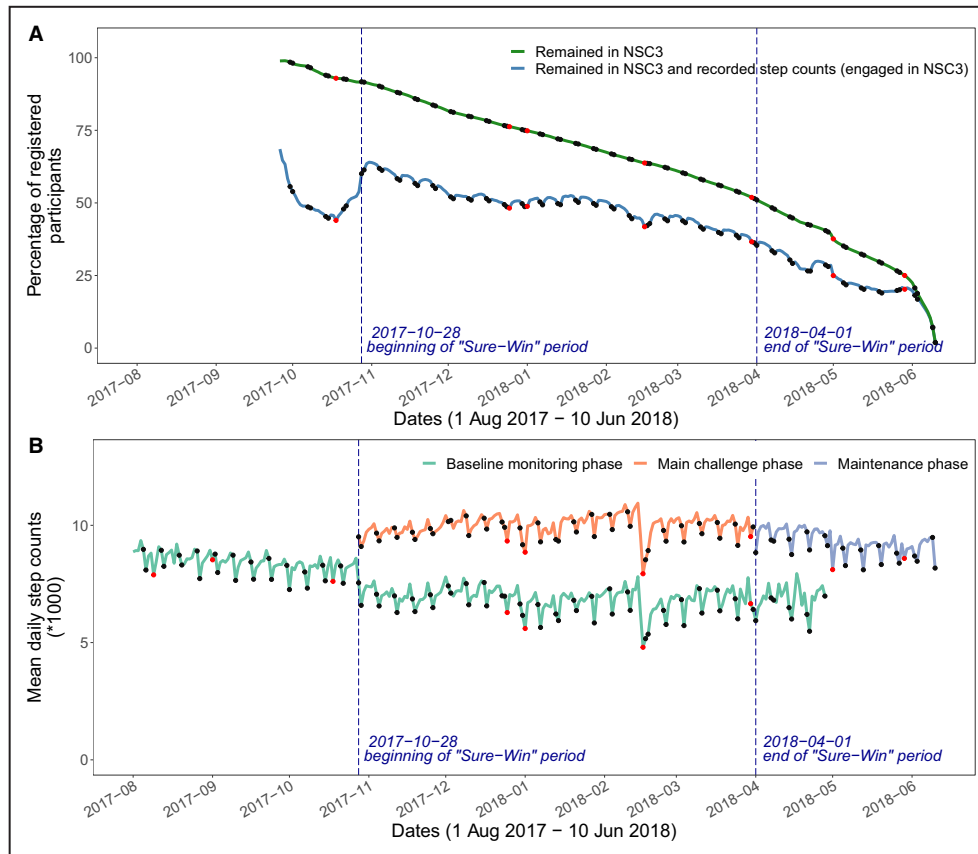
**Table 2. Duration and Percentage of Engagement and Mean Daily Step Counts During NSC3 (N=421 388)**

Characteristics	Duration of engagement in days, median (IQR)	Percentage of engagement, median (IQR)	Mean daily step counts, mean (SD)
Total	74 (14–149)	36 (7–68)	8184 (4073)
Nationality			
Singapore citizen	81 (16–153)	41 (8–70)	8346 (4134)
Noncitizen	60 (10–140)	28 (5–62)	7870 (3933)
Sex			
Female	79 (15–152)	38 (8–69)	7931 (3925)
Male	67 (12–144)	33 (6–66)	8543 (4247)
Age, y			
17–39	54 (10–129)	27 (5–59)	7839 (3686)
40–59	94 (19–165)	46 (10–74)	8403 (4238)
60–79	108 (20–173)	52 (10–79)	8912 (4847)
≥80	108 (29–163)	51 (15–73)	9077 (4869)
Body mass index, kg/m <sup>2</sup>			
<18.5	68 (12–141)	33 (6–64)	7870 (4017)
18.5 to <23	79 (15–152)	39 (8–68)	8309 (4036)
23 to <27.5	75 (14–151)	37 (7–69)	8291 (4131)
≥27.5	59 (11–139)	29 (5–64)	7762 (4028)
Registration for previous NSC season			
No	46 (7–127)	23 (4–61)	7602 (4098)
Yes	120 (49–179)	53 (23–77)	9251 (3803)
NSC3 registration time			
Before Sure-Win period	127 (38–186)	52 (16–76)	8871 (4062)
Within 30 days since Sure-Win period began	60 (11–133)	28 (5–61)	7940 (4023)
>30 days after Sure-Win period began	24 (4–75)	18 (3–52)	7208 (3939)
Wearables			
HPB-issued	64 (13, 136)	31 (6, 62)	8698 (4589)
Phone-based	43 (2, 135)	23 (1, 65)	6831 (3486)
Commercial	96 (29, 165)	46 (15, 74)	9769 (3402)
>1 wearable type	114 (41, 170)	53 (20, 75)	8673 (3609)

Participant characteristics for the 421 388 participants can be found in Table S8. Data of engagement and daily step counts by the NSC3 phases in mean (SD) can be found in Tables S3 and S4. Comparisons by participant characteristics using Kruskal-Wallis tests and ANOVA tests: all  $P < 0.001$ . Percentage of engagement was relative to participants' available NSC3 days (median of available NSC3 days: 223 days; IQR, 205–240 days). HPB indicates Health Promotion Board Singapore; NSC, National Steps Challenge; and NSC3, NSC Season 3.

intervention program and was not conceptualized as a research study. As such, our evaluation relies on routinely collected data and does not have the same internal validity and quality of outcome measures as a purposefully designed randomized controlled trial. Besides, the availability of physical activity measurements depends on participants' program engagement. The estimates of effectiveness could therefore be subject to bias and confounding. We conducted multiple sensitivity and secondary analyses to address this concern and found that our observations were robust. Second, despite its large reach, certain subpopulations including the obese and elderly were underrepresented. Although the large sample

size enabled us to conduct subgroup analysis, it is conceivable that individuals in specific subgroups may fail to represent the corresponding population groups. This may partially explain the higher activity level and activity increase, for example, in older participants. Third, the duration and intensity of the NSC3 intervention varied among participants because of their different registration dates and involvement in the subchallenges. However, this reflects the real-life nature of the NSC3. Fourth, the maintenance phase in the current evaluation was relatively short, and the program's effectiveness may be affected by other confounders unavailable. Therefore, further investigations with longer follow-up and more



**Figure 4. Percentage of daily step recording and the mean daily step counts over time (N=421 388).**

**A**, Percentage of registered participants on each calendar date who engaged in NSC3 as well as who remained in NSC3. Registered participants for a specific calendar date reflected all the participants who registered for NSC3 by that date. A registered participant remained in NSC3 until the last day the participant recorded daily step counts. **B**, Mean daily step counts on each calendar date, stratified according to the 3 specified NSC3 phases (baseline monitoring phase, main challenge phase, and maintenance phase). Black dots indicate weekend days; red dots indicate nonweekend public holidays. N=421 388 reflects the total number of participants who contributed data to Figure 4, but the mean daily step counts on specific dates were computed on the basis of participants who provided step count data on the date. The number of participants in each NSC3 phase with step count data on each calendar date can be found in Table S9. NSC3 indicates National Steps Challenge Season 3.

comprehensive assessments of confounders are warranted. Finally, information on the cost effectiveness of health promotion programs is important in terms of program sustainability and potential implementation in other countries. At this stage, we are not able to include a cost-effectiveness analysis of the NSC3 because of the lack of relevant data. However, in Singapore, the NSC has benefited from multisectoral collaborations and effects of economies of scale.<sup>14</sup> The program has continued since 2015 and its sixth yearly season started in October 2021.<sup>37</sup> While future cost-effectiveness analyses of NSC and similar mHealth programs are essential for policy makers, the NSC's continuous implementation could be an indicator of the program's sustainability, at least in high-income settings.

## CONCLUSIONS

The NSC represents an mHealth physical activity intervention on a large scale. Our evaluation shows that the NSC3 reached a very large and diverse population from across the country within a few months. While NSC3 engagement was not ideal and declined steadily over time, it appears to compare favorably with other scaled-up mHealth programs. Moreover, substantial and clinically meaningful increases in daily step counts were achieved and maintained during the NSC3. This evaluation also extends current knowledge on factors associated with uptake, engagement, and effectiveness of mHealth interventions, and suggests directions for future program improvement. In sum, the evaluation presents an

**Table 3. Mean Daily Step Count During the Baseline Monitoring Phase and Changes in Mean Daily Step Count From Baseline to the Main Challenge Phase and the Maintenance Phase (N=384 691)**

Characteristics	Mean daily step count during the baseline monitoring phase, mean (SD)	Changes of mean daily step counts from baseline monitoring phase, model estimate (95% CI)	
		Main challenge phase	Maintenance phase
Total	7509 (3467)	1579 (1564–1594)	934 (916–952)
Nationality			
Singapore citizen	7591 (3612)	1864 (1844–1883)	1148 (1125–1171)
Noncitizen	7410 (3284)	1225 (1203–1247)	722 (693–750)
Sex			
Female	7114 (3337)	1707 (1688–1725)	1055 (1033–1077)
Male	8106 (3574)	1488 (1463–1512)	881 (852–911)
Age, y			
17–39	7267 (3063)	1280 (1260–1300)	827 (802–852)
40–59	7638 (3650)	1852 (1828–1875)	1123 (1095–1151)
60–79	8161 (4318)	2303 (2252–2353)	1377 (1319–1436)
≥80	8027 (4672)	2767 (2511–3023)	1633 (1336–1929)
Body mass index, kg/m <sup>2</sup>			
<18.5	7042 (3467)	1651 (1589–1712)	989 (916–1063)
18.5 to <23	7517 (3477)	1673 (1651–1696)	1027 (1000–1055)
23 to <27.5	7664 (3480)	1621 (1596–1645)	984 (954–1014)
≥27.5	7325 (3389)	1472 (1436–1508)	892 (848–937)
Registration for previous NSC season			
No	6875 (3307)	1635 (1614–1656)	1184 (1158–1209)
Yes	8223 (3505)	1625 (1604–1645)	756 (732–781)
NSC3 registration time			
Before Sure-Win period	7889 (3593)	1781 (1761–1800)	932 (908–957)
Within 30 d since Sure-Win period began	6999 (3177)	1375 (1347–1403)	903 (870–937)
>30 d after Sure-Win period began	6523 (2988)	1307 (1267–1347)	990 (945–1035)
Wearables			
HPB-issued	8519 (4397)	1999 (1965–2034)	1085 (1044–1126)
Phone-based	7054 (2932)	738 (720–756)	322 (301–344)
Commercial	9456 (3261)	1028 (989–1067)	592 (545–640)
>1 wearable	6993 (3109)	2353 (2326–2379)	1749 (1715–1782)
Quartiles of engagement duration in days			
<15	6301 (2995)	166 (121–212)	413 (310–517)
15–74	6975 (3144)	893 (864–922)	735 (695–775)
75–149	7480 (3394)	2004 (1974–2034)	1377 (1341–1413)
150–258	8471 (3636)	2052 (2029–2075)	1229 (1202–1256)

Results were based on step records that comprised the reliable phase-specific mean daily step count. A reliable phase-specific mean daily step count required at least 4 records of daily step counts during the corresponding NSC3 phase. Changes in mean daily step counts were estimated by linear mixed-effect models, adjusting for nationality, sex, age, body mass index, registration for previous NSC season, NSC3 registration time, wearable used, and numeric duration of engagement where applicable. For each participant subgroup, a separate model was fitted using data from the corresponding subgroup. All model estimates were  $P < 0.001$ . Participant characteristics for the 384 691 participants can be found in Table S8. HPB indicates Health Promotion Board Singapore; NSC, National Steps Challenge; and NSC3, NSC Season 3.

encouraging example for researchers, practitioners, and policy makers around the world to scale up effective physical activity interventions.

## ARTICLE INFORMATION

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Author contributions: Drs Riemenschneider and Tan conceived the study and led all stages of the program evaluation. Drs Riemenschneider, Tan, Matthias Müller, and Chen, and N.Lim, J. Tan, and J. Yao coordinated the collaboration and data acquisition. N.Lim and J. Tan provided expertise on the program implementation. J. Yao drafted the analysis plan and performed the analysis under the guidance of Drs Riemenschneider, Tan, and Martinus van Dam. J. Yao and Dr Riemenschneider drafted the manuscript with critical inputs from Drs van Dam and Tan. All authors reviewed the final version of the manuscript and agreed on the submission.

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### Disclosures

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### Supplemental Material

Data S1–S4

Tables S1–S9

Figures S1–S3

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## **SUPPLEMENTAL MATERIAL**

This is the supplemental materials for the manuscript “Evaluation of a population-wide mobile health physical activity program in 696,907 adults in Singapore”.

Data S1: Systematic search on scaled-up mobile health physical activity interventions.

Figure S1: PRISMA flow diagram for the systematic search for scaled-up mHealth physical activity intervention.

Table S1: Scaled-up mHealth physical activity interventions through the systematic search.

Data S2: Population Statistics and classification of participant characteristics and wearables.

Data S3: The uptake of National Steps Challenge Season Three in absolute number and the percentage of uptake by Singapore planning areas.

Figure S2: Singapore population aged 17+ years and NSC3 uptake by Singapore planning areas (N = 619,134)

Figure S3: Scatter plots of Singapore population aged 17+ years vs. NSC3 uptake by planning areas (N = 619,134).

Data S4: Comparison of daily step count by the day of the week and public holiday.

Table S2: Mean daily step count and difference by the day of the week or public holiday (N = 421,388).

Table S3: Mean duration and percentage of engagement (N = 421,388).

Table S4: Mean daily step count by participant characteristics and NSC3 phase (N = 421,388).

Table S5: Changes in mean daily step count from the baseline monitoring phase to the main challenge phase and maintenance phase using complete-case analysis (N = 96,248).

Table S6: Changes in mean daily step count from the baseline monitoring phase, using thresholds of 1-30 days for phase-specific mean daily step count (N = 421,388).

Table S7: Changes in mean daily step count from the baseline monitoring phase to the main challenge phase and maintenance phase, only including records of daily steps at least 1500 steps (N = 378,550).

Table S8: NSC3 participant characteristics (N = 539,296) stratified by data availability

Table S9: Number of participants who provided step count data on each day of the entire evaluation period according to NSC3 phases

## **Data S1: Systematic search on scaled-up mobile health physical activity interventions**

In the Lancet Series on physical activity in 2016, a systematic review of the peer-reviewed literature on the scaled-up physical activity interventions was conducted, including literature up to December 2015<sup>2</sup>. In this study, we extended the literature to 01 January 2020 while restricting the search to mobile health (mHealth) interventions.

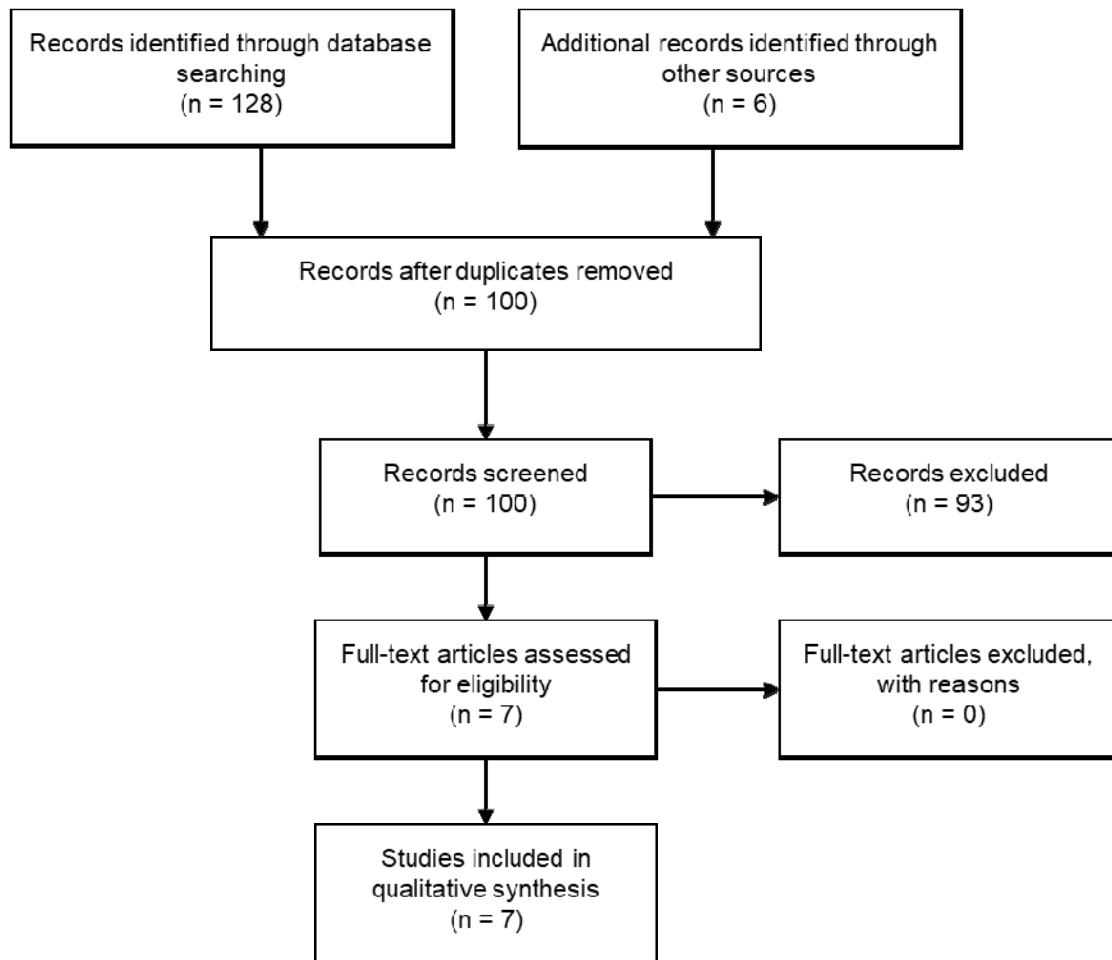
Except for the additional search terms of mHealth, we used the same search process and criteria as that of the systematic review in the Lancet Series on physical activity in 2016 where the details can be found<sup>2</sup>. In brief, we searched PubMed and Scopus databases for publications between January 2016 to 01 January 2020 to identify scaled-up mHealth physical activity interventions. Three types of search terms were included: scalability, physical activity, and mHealth. We extracted the publications that contain a scalability search term in the title and a physical activity term and a mHealth search term in the title or abstract. The details of the search terms are as followed:

mHealth: telemedicine OR telehealth OR eHealth OR mhealth OR m-health OR “m health” OR “mobile health” OR “mobilehealth” OR “mobile-health” OR “mobile devic\*” OR phone OR smartphone OR “handheld computer” OR cellphone OR telephone OR SMS OR “text messag\*” OR “short messag\*” OR “health messag\*” OR “multimedia messag\*” OR “multi-media messag\*” OR “mobile technology” OR “mobile communication” OR “mobile app\*” OR app OR “wearable\*” OR “body worn sensor\*” OR smartwatch\* OR accelerometer\* OR accelerometry OR pedometer\* OR tracker\* OR “mobile computing” OR “wireless technology” OR “wireless devic\*” OR “bluetooth” OR “mobile operating system\*” OR android OR ios OR “social media” OR “social network\*” OR “remote monitoring” OR “remote consultat\*” OR teleconsult\* OR telehealthcare OR telemonitor\* OR tele-education OR “remote diagnosis” OR telemanagement OR tele-management.

Scalability<sup>1</sup>: scaled-up OR scale-up OR scaling-up OR scalability OR scalable OR reach OR expanding OR expandable OR expandability OR institutionalization OR institutionalisation OR roll-out OR rolling-out OR dissemination OR disseminating.

Physical activity<sup>1</sup>: “physical activity” OR “physically active” OR “physical inactivity” OR “physically inactive” OR fitness OR exercis\* OR sport\* OR walk OR walking OR sedentary OR sitting OR television OR TV OR “screen time” OR screen-time OR “active transport\*” OR “active transit” OR “active travel” OR commut\* OR “active commuting” OR bicycle OR bicycling OR bike OR biking OR “active living” OR active-living.

The search from PubMed and Scopus databases yielded 128 articles (93 unique articles) published between 2016 and 2019. Two additional studies published before 2016 were identified directly from 16 scaled-up physical activity interventions found in the systematic review in the Lancet Series on physical activity in 2016<sup>2</sup>, and four were identified through manual web search. In total, seven mHealth physical activity scaled-ups were found (Figure S1, Table S1).



**Figure S1: PRISMA flow diagram for the systematic search for scaled-up mHealth physical activity intervention.**

**Table S1: Scaled-up mHealth physical activity interventions through the systematic search.**

Study	Reference
The 10,000 Steps Australia programme	Rayward AT, Vandelanotte C, Corry K, Van Itallie A, Duncan MJ. Impact of a social media campaign on reach, uptake, and engagement with a free web-and app-based physical activity intervention: The 10,000 steps Australia program. <i>Int J Environ Res Public Health</i> 2019; <b>16</b> . DOI:10.3390/ijerph16245076.
Carrot Rewards	Mitchell M, White L, Lau E, Leahey T, Adams MA, Faulkner G. Evaluating the carrot rewards app, a population-level incentive-based intervention promoting step counts across two canadian provinces: Quasi-experimental study. <i>JMIR mHealth uHealth</i> 2018; <b>6</b> : 1–13.
Go365	Patel MS, Foschini L, Kurtzman GW, <i>et al.</i> Using Wearable Devices and Smartphones to Track Physical Activity: Initial Activation, Sustained Use, and Step Counts Across Sociodemographic Characteristics in a National Sample. <i>Ann Intern Med</i> 2017; <b>167</b> : 755–7.
Sweatcoin	Elliott M, Eck F, Khmelev E, Derlyatka A, Fomenko O. Physical activity behavior change driven by engagement with an incentive-based app: Evaluating the impact of sweatcoin. <i>J Med Internet Res</i> 2019; <b>21</b> : 1–15.
The Stepathlon Study	Ganesan AN, Louise J, Horsfall M, <i>et al.</i> International Mobile-Health Intervention on Physical Activity, Sitting, and Weight: The Stepathlon Cardiovascular Health Study. <i>J Am Coll Cardiol</i> 2016; <b>67</b> : 2453–63.
Txt4health programme	Buis LR, Hirzel L, Turske SA, Des Jardins TR, Yarandi H, Bondurant P. Use of a text message program to raise type 2 diabetes risk awareness and promote health behavior change (Part I): Assessment of participant reach and adoption. <i>J Med Internet Res</i> 2013; <b>15</b> . DOI:10.2196/jmir.2928.
Hello World programme	Van Dongen JM, Van Poppel MN, Milder IE, Van Oers HA, Brug J. Exploring the reach and program use of hello world, an email-based health promotion program for pregnant women in the Netherlands. <i>BMC Res Notes</i> 2012; <b>5</b> . DOI:10.1186/1756-0500-5-514.

## **Data S2: Population Statistics and classification of participant characteristics and wearables**

Singapore population statistics of demographics were sourced from the United Nations website (year 2018) and Department of Statistics Singapore (year 2018). The population statistics of body mass index were extracted from Singapore National Health Survey (year 2010)<sup>38-40</sup>.

We calculated the BMI for NSC3 participants by dividing the weight by the height squared, and categorised it into 4 groups according to cut-off points for Asian population<sup>40,41</sup>: less than 18.5 (underweight), from 18.5 to less than 23 (normal weight), from 23 to less than 27.5 (overweight but not obese), and 27.5 and above (obese) kg/m<sup>2</sup>. We derived participant age as the rounded years between the birth year to 2017-10-28, and classified it into 4 groups: 17-39, 40-59, 60-79, and 80+ years.

We classified the detail wearable models used by NSC3 participants into HPB-issued wearables, phone-based wearables or commercial wearables. The HPB-issued wearables include the following input wearable sources in the collected data: “HPB\_Careeach”, “HPB\_Mova”, “HPB\_Skytech”, “HPB\_Tempo”, “HPB\_Xtep”, “HPB\_Aibi”, “HPB\_Stride”, “HPB\_Apex”, and “HPB\_unspecified”. The phone-based wearables include the following input wearable sources in the data: “HealthKit”, “SHealth”, “CoreMotion”, “GoogleFit”, “Accelerometer”, “NoWearable”. “Accelerometer” and “NoWearable” were very rare (total 0.15%) and were believed to result from minor smartphone models which may have compatibility issues for the system to register the model names properly. The commercial wearables include the following input wearable sources in the data: “FitBit” and “Actxa”.



### **Data S3: The uptake of National Steps Challenge Season Three (NSC3) in absolute number and the percentage of uptake by Singapore planning areas**

In total, 619,134 out of the 696,794 NSC3 participants provided valid first two digits of the postcodes. There are in total 55 planning areas in Singapore and a full postcode in Singapore contains six digits<sup>42,43</sup>. Among these 619,134 NSC3 participants, we displayed the NSC3 uptake by Singapore planning areas on the Singapore map<sup>43</sup>. The same was done for the percentage of NSC3 uptake specific to each planning area among the entire target population, as well as the entire target population (aged 17 years and above) in Singapore (Figure S2-S3).

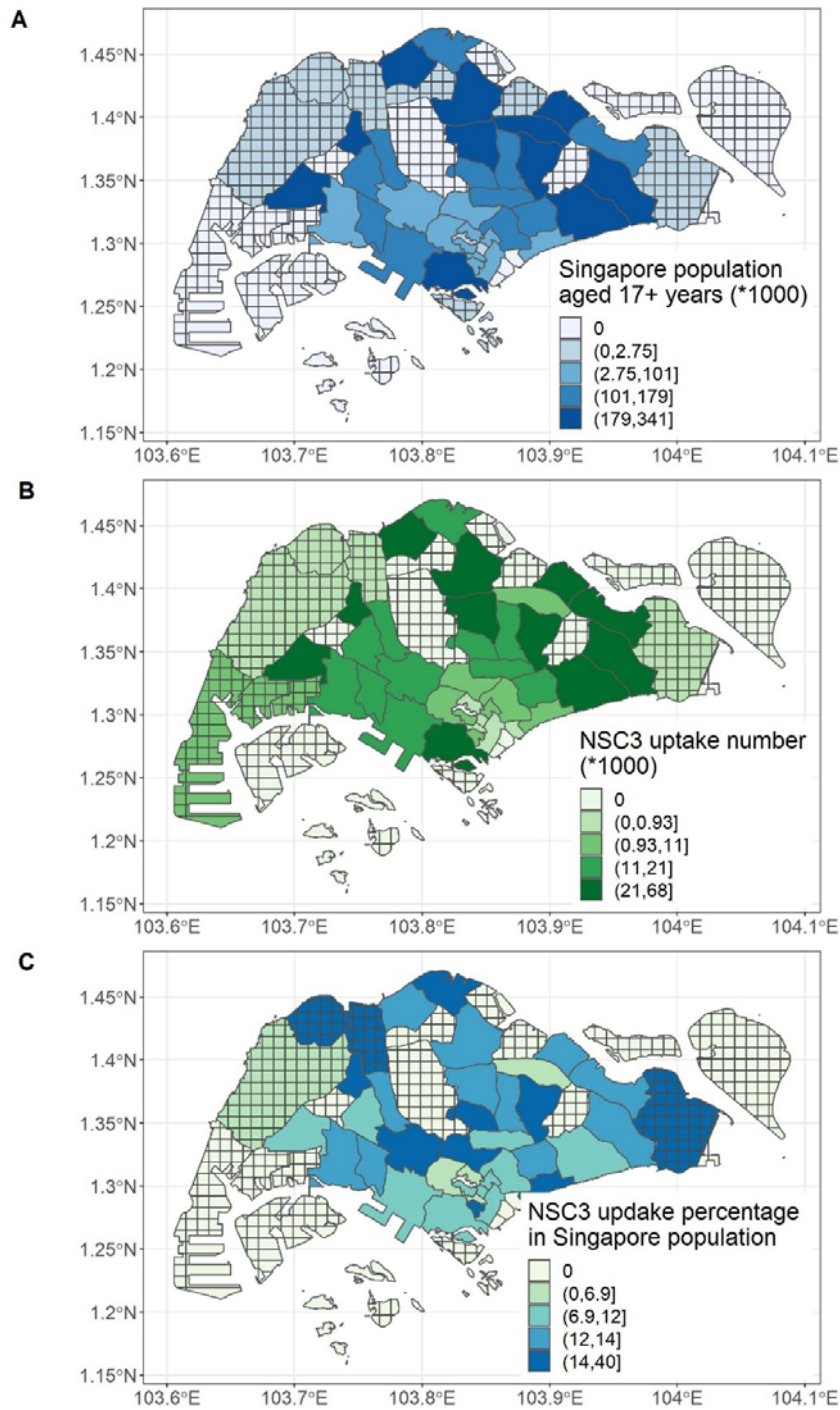
Because the first two digits of the Singapore postcode are not enough to identify the corresponding planning area in Singapore, we first assigned each unique first two digits of postcodes to the planning areas using the following approximation. We mapped all the possible Singapore postcodes on the Singapore map, and calculate the location centroids for those with the same first two digits. The planning area where a location centroid sit was considered as the planning area for all the postcodes with the corresponding first two digits.

After determining the planning area for each participant, NSC3 uptake in absolute numbers by planning area was calculated by summing up the number of NSC3 participants that belong to each planning area.

To estimate the percentage of NSC3 uptake by planning areas, we first estimated the size of the entire NSC3 target population by planning areas – the entire Singapore population (citizens and noncitizens) aged 17 years and above. We used the population statistics of 2018 from both Department of Statistics, Singapore and the United Nations website for this step because, to our knowledge, no single source provided full information needed. Population size of citizens by planning area, age groups and by nationality came from Department of Statistics, Singapore<sup>44</sup>. Population size of the entire Singapore population by age groups came from the United Nations website<sup>38</sup>. We assumed the same geographical distributions by planning areas of citizens versus noncitizens and those aged 17+ years versus those below 17 years.

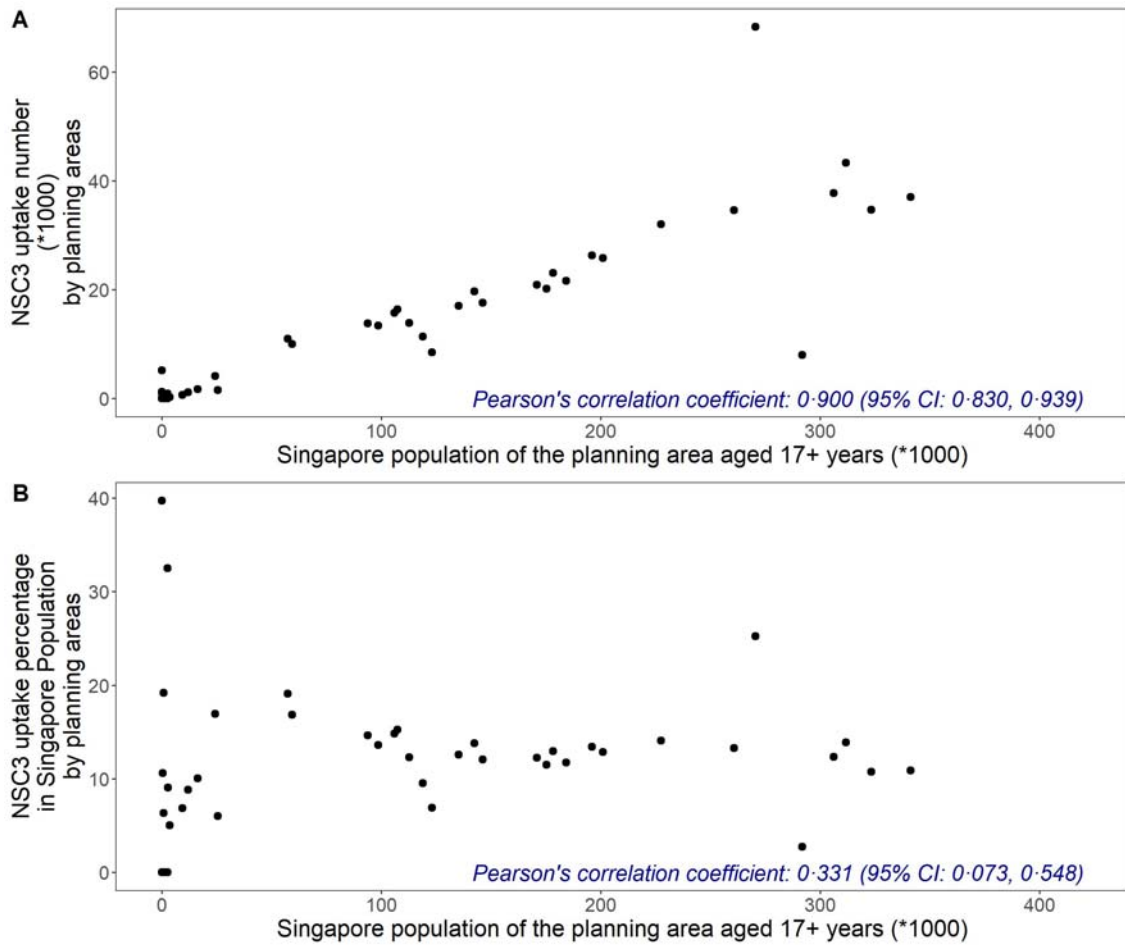
The percentage of NSC3 uptake of a planning area was calculated by dividing the total NSC3 participants in the planning area by the entire Singapore population aged 17 years and above in the corresponding planning area. The uptake percentage of non-residential planning area was set as zero.

The analyses were conducted using R (version 3.6.1).



**Figure S2: Singapore population aged 17+ years and NSC3 uptake by Singapore planning areas (N = 619,134)**

A) Total population aged 17+ years in Singapore; B) NSC3 uptakes in absolute number; C) Singapore uptake percentage in the target population. Areas with grid lines have population densities less than 500 person/km<sup>2</sup>, mainly consisting of parks and nature reserves or industrial areas. NSC3: National Steps Challenge Season Three.



**Figure S3: Scatter plots of Singapore population aged 17+ years vs. NSC3 uptake by planning areas (N = 619,134).**

NSC3: National Steps Challenge Season Three.

#### Data S4: Comparison of daily step count by the day of the week and public holiday

Calendar dates during NSC3 were categorised by the day of the week. But if a calendar date belonged to a public holiday in Singapore, it was labelled as “public holiday” instead. We calculated the overall mean daily step count on each calendar, which was further summarised by the day of the week and public holiday (Table S2). We also calculated the mean daily step count on each calendar date by NSC3 phases. The mean daily step count on each calendar date by NSC3 phases were used to fit a linear mixed effect model to compare difference by the day of the week and public holidays. Phase-specific random intercepts and independent correlation matrix were specified in the linear mixed effect model (Table S2).

**Table S2: Mean daily step count and difference by the day of the week or public holiday (N = 421,388).**

Day of the week and public holiday	Overall mean daily step count, mean (SD)	Model effect estimate (95% CI)	p-value
Monday	8461 (1367)	reference	.
Tuesday	8573 (1362)	139 (-76 to 353)	0.205
Wednesday	8613 (1374)	123 (-91 to 338)	0.259
Thursday	8598 (1363)	124 (-89 to 338)	0.254
Friday	8894 (1298)	432 (216 to 649)	<0.001
Saturday	8514 (1363)	40 (-173 to 254)	0.711
Sunday	7869 (1441)	-616 (-829 to -403)	<0.001
Public holiday	7646 (1495)	-789 (-1136 to -442)	<0.001

**Table S3: Mean duration and percentage of engagement (N = 421,388).**

<b>Characteristics</b>	<b>Duration of engagement (days)</b>	<b>Percentage of engagement</b>
<b>Total</b>	87 (75)	40 (32)
<b>Nationality</b>		
Singapore citizen	91 (75)	42 (33)
Noncitizen	80 (74)	35 (31)
<b>Sex</b>		
Female	90 (76)	40 (32)
Male	84 (74)	38 (32)
<b>Age, y</b>		
17-39	74 (69)	34 (30)
40-59	98 (78)	44 (33)
60-79	104 (80)	47 (35)
80+	104 (76)	47 (32)
<b>Body mass index, kg/m<sup>2</sup></b>		
<18.5	83 (73)	37 (32)
18.5 to <23	90 (75)	41 (32)
23 to <27.5	88 (76)	40 (33)
>=27.5	80 (74)	36 (32)
<b>Registration for previous NSC season</b>		
No	71 (70)	34 (32)
Yes	117 (75)	50 (31)
<b>NSC3 registration time</b>		
Before “Sure-Win” period	118 (80)	48 (32)
Within 30 days since “Sure-Win” period began	76 (67)	35 (31)
Over 30 days after “Sure-Win” period began	44 (47)	29 (30)
<b>Wearables</b>		
HPB-issued	81 (71)	36 (31)
Phone-based	73 (77)	34 (34)
Commercial	102 (76)	46 (32)
More than one wearable type	110 (73)	49 (31)

Data in mean (SD). NSC: National Steps Challenge; NSC3: NSC Season Three; HPB: Health Promotion Board, Singapore.



**Table S4: Mean daily step count by participant characteristics and NSC3 phase (N = 421,388).**

<b>Characteristics</b>	<b>Baseline monitoring phase</b>	<b>Main challenge phase</b>	<b>Maintenance phase</b>
<b>Total</b>	6707 (4020)	8580 (4181)	8792 (4424)
<b>Nationality</b>			
Singapore citizen	6762 (4138)	8647 (4273)	8897 (4438)
Noncitizen	6641 (3872)	8436 (3974)	8549 (4381)
<b>Sex</b>			
Female	6388 (3847)	8349 (4033)	8475 (4227)
Male	7182 (4219)	8908 (4362)	9271 (4664)
<b>Age, y</b>			
17-39	6594 (3651)	8149 (3797)	8405 (4124)
40-59	6797 (4180)	8854 (4341)	8949 (4538)
60-79	6884 (4875)	9435 (4877)	9585 (4831)
80+	6785 (5014)	9552 (4941)	9194 (5297)
<b>Body mass index, kg/m<sup>2</sup></b>			
<18.5	6245 (3949)	8285 (4137)	8372 (4334)
18.5 to <23	6754 (4030)	8708 (4153)	8831 (4420)
23 to <27.5	6826 (4051)	8685 (4231)	8932 (4472)
>=27.5	6505 (3928)	8139 (4127)	8529 (4335)
<b>Registration for previous NSC season</b>			
No	5899 (3951)	7987 (4189)	8657 (4503)
Yes	7743 (3867)	9580 (3972)	8980 (4305)
<b>NSC3 registration time</b>			
Before “Sure-Win” period	7061 (4157)	9530 (4082)	9087 (4522)
Within 30 days since “Sure-Win” period began	6228 (3730)	8115 (4108)	8675 (4464)
Over 30 days after “Sure-Win” period began	5743 (3533)	7474 (4117)	8278 (4020)
<b>Wearables</b>			
HPB-issued	7121 (5016)	9007 (4620)	9229 (5125)
Phone-based	6415 (3446)	7262 (3570)	7788 (3224)
Commercial	9157 (3523)	9969 (3482)	10085 (3810)

Data in mean (SD). Comparison of mean daily step count for each NSC3 phases by participant characteristics using one-way ANOVA: all p-values < 0.001. NSC: National Steps Challenge; NSC3: NSC Season Three; HPB: Health Promotion Board, Singapore.

**Table S5: Changes in mean daily step count from the baseline monitoring phase to the main challenge phase and maintenance phase using complete-case analysis (N = 96,248).**

Characteristics	Main challenge phase	Maintenance phase
<b>Total</b>	1792 (1771 to 1813)	1065 (1041 to 1090)
<b>Nationality</b>		
Singapore citizen	2054 (2026 to 2083)	1184 (1152 to 1216)
Noncitizen	1396 (1365 to 1427)	886 (850 to 923)
<b>Sex</b>		
Female	1851 (1825 to 1877)	1113 (1084 to 1143)
Male	1697 (1661 to 1732)	988 (946 to 1030)
<b>Age, y</b>		
17-39	1449 (1419 to 1478)	939 (904 to 973)
40-59	1977 (1944 to 2009)	1146 (1109 to 1183)
60-79	2305 (2237 to 2374)	1200 (1124 to 1277)
80+	2484 (2091 to 2877)	1457 (1034 to 1880)
<b>Body mass index, kg/m<sup>2</sup></b>		
< 18.5	1843 (1750 to 1936)	1107 (1004 to 1209)
18.5 to <23	1830 (1797 to 1862)	1100 (1063 to 1137)
23 to <27.5	1794 (1759 to 1829)	1046 (1005 to 1086)
>=27.5	1661 (1610 to 1713)	999 (938 to 1060)
<b>Registration for previous NSC season</b>		
No	2046 (2010 to 2081)	1521 (1480 to 1562)
Yes	1607 (1582 to 1633)	734 (705 to 763)
<b>NSC3 registration time</b>		
Before “Sure-Win” period	1820 (1795 to 1844)	972 (944 to 1001)
Within 30 days since “Sure-Win” period began	1707 (1660 to 1753)	1268 (1214 to 1322)
Over 30 days after “Sure-Win” period began	1751 (1668 to 1834)	1426 (1339 to 1514)
<b>Wearables</b>		
HPB-issued	2059 (2002 to 2116)	801 (736 to 866)
Phone-based	865 (841 to 888)	385 (358 to 412)
Commercial	1124 (1077 to 1171)	606 (548 to 664)
More than one wearable	2595 (2557 to 2633)	1891 (1847 to 1936)
<b>Quartiles of engagement duration (days)</b>		
< 15	247 (-140 to 634)	502 (-41 to 1045)
15-74	864 (798 to 931)	711 (634 to 787)
75-149	1531 (1488 to 1575)	1026 (975 to 1076)
150-258	2003 (1977 to 2029)	1124 (1095 to 1154)

Data are model estimates of changes in mean daily step count (95% CI). Complete-case analysis only include participants with reliable mean daily step count for all NSC3 phases. A phase-specific reliable mean daily step count requires at least four days of daily step counts in the corresponding NSC3 phase. Linear mixed effect models with participant-specific intercepts and unstructured within-participant correlation matrix were used. The models adjusted for nationality, sex, age, BMI, registration for previous NSC season, NSC3 registration time, wearable used, and numeric duration of engagement where applicable. For each participant subgroup, a separate model was fitted using data from the corresponding subgroup to estimate the changes. All model estimates had p-value <0.001. NSC: National Steps Challenge; NSC3: NSC Season Three; HPB: Health Promotion Board, Singapore.

**Table S6: Changes in mean daily step count from the baseline monitoring phase, using thresholds of 1-30 days for phase-specific mean daily step count (N = 421,388).**

Threshold (days)	Non-complete-case analysis		Complete-case analysis	
	Main challenge phase	Maintenance phase	Main challenge phase	Maintenance phase
1	1985 (1969 to 2002)	1281 (1261 to 1300)	2346 (2322 to 2369)	1522 (1496 to 1548)
2	1705 (1690 to 1720)	1032 (1013 to 1050)	1948 (1926 to 1969)	1179 (1155 to 1203)
3	1615 (1600 to 1630)	960 (942 to 978)	1841 (1820 to 1862)	1099 (1075 to 1123)
4	1579 (1564 to 1594)	934 (916 to 952)	1792 (1771 to 1813)	1065 (1041 to 1090)
5	1560 (1546 to 1575)	923 (905 to 941)	1761 (1740 to 1782)	1044 (1019 to 1068)
6	1550 (1536 to 1565)	921 (903 to 939)	1735 (1714 to 1756)	1029 (1005 to 1054)
7	1543 (1528 to 1558)	923 (904 to 941)	1715 (1694 to 1737)	1021 (997 to 1046)
8	1590 (1574 to 1606)	970 (951 to 989)	1689 (1666 to 1711)	955 (929 to 982)
9	1563 (1546 to 1579)	944 (924 to 964)	1650 (1627 to 1673)	904 (877 to 931)
10	1549 (1533 to 1566)	935 (915 to 954)	1630 (1606 to 1653)	886 (859 to 913)
11	1543 (1526 to 1559)	933 (913 to 953)	1617 (1593 to 1640)	873 (846 to 901)
12	1537 (1520 to 1554)	930 (910 to 951)	1610 (1586 to 1634)	868 (840 to 896)
13	1529 (1511 to 1546)	923 (902 to 943)	1596 (1572 to 1620)	851 (823 to 880)
14	1524 (1506 to 1541)	922 (901 to 942)	1586 (1561 to 1610)	842 (814 to 870)
15	1517 (1500 to 1535)	919 (899 to 940)	1578 (1553 to 1603)	835 (806 to 863)
16	1513 (1495 to 1531)	919 (898 to 940)	1576 (1550 to 1601)	829 (799 to 858)
17	1506 (1487 to 1524)	912 (891 to 933)	1566 (1541 to 1592)	814 (784 to 843)
18	1503 (1485 to 1522)	913 (891 to 934)	1562 (1536 to 1588)	808 (778 to 838)
19	1503 (1484 to 1522)	914 (892 to 936)	1562 (1536 to 1588)	802 (772 to 832)
20	1498 (1479 to 1517)	912 (890 to 935)	1556 (1530 to 1583)	796 (765 to 827)
21	1494 (1474 to 1513)	914 (891 to 936)	1549 (1522 to 1576)	792 (761 to 824)
22	1489 (1470 to 1509)	913 (890 to 935)	1547 (1520 to 1574)	791 (759 to 822)
23	1487 (1467 to 1507)	913 (890 to 936)	1543 (1515 to 1571)	791 (758 to 823)
24	1487 (1466 to 1507)	917 (893 to 940)	1540 (1512 to 1568)	787 (754 to 820)
25	1486 (1465 to 1506)	919 (895 to 942)	1541 (1513 to 1570)	788 (755 to 821)
26	1483 (1462 to 1504)	920 (896 to 943)	1537 (1508 to 1566)	785 (751 to 818)
27	1482 (1461 to 1503)	922 (898 to 946)	1537 (1508 to 1567)	788 (754 to 822)
28	1478 (1457 to 1499)	915 (891 to 940)	1534 (1504 to 1564)	781 (747 to 816)
29	1480 (1458 to 1501)	914 (889 to 939)	1530 (1500 to 1560)	776 (742 to 811)
30	1479 (1457 to 1500)	911 (886 to 936)	1530 (1500 to 1561)	779 (743 to 814)

Data are model estimates of changes in mean daily step count (95% CI). For thresholds of four days or above, the phase-specific mean daily step count was reliable with intraclass correlation coefficient more than 80%. Complete-case analysis only included participants with mean daily step count for all NSC3 phases. Linear mixed effect models with participant-specific intercepts and unstructured within-participant correlation matrix were used. The models adjusted for nationality, sex, age, BMI, registration for previous NSC season, NSC3 registration time, wearable used, and numeric duration of engagement. All model estimates had p-value <0.001. NSC: National Steps Challenge; NSC3: NSC Season Three.

**Table S7: Changes in mean daily step count from the baseline monitoring phase to the main challenge phase and maintenance phase, only including records of daily steps at least 1500 steps (N = 378,550).**

<b>Characteristics</b>	<b>Main challenge phase</b>	<b>Maintenance phase</b>
<b>Total</b>	1389 (1375 to 1403)	827 (809 to 844)
<b>Nationality</b>		
Singapore citizen	1654 (1635 to 1673)	1023 (1001 to 1046)
Noncitizen	1060 (1039 to 1080)	636 (608 to 663)
<b>Sex</b>		
Female	1460 (1442 to 1478)	881 (860 to 903)
Male	1278 (1254 to 1301)	738 (709 to 767)
<b>Age, y</b>		
17-39	1128 (1109 to 1147)	739 (714 to 763)
40-59	1590 (1567 to 1613)	933 (906 to 961)
60-79	1841 (1793 to 1888)	1004 (948 to 1060)
80+	2014 (1778 to 2250)	1010 (740 to 1281)
<b>Body mass index, kg/m<sup>2</sup></b>		
< 18.5	1430 (1408 to 1452)	860 (834 to 887)
18.5 to <23	1385 (1327 to 1444)	801 (731 to 872)
23 to <27.5	1393 (1369 to 1417)	825 (795 to 854)
>=27.5	1270 (1236 to 1305)	748 (704 to 791)
<b>Registration for previous NSC season</b>		
No	1427 (1407 to 1448)	1016 (991 to 1041)
Yes	1376 (1357 to 1395)	624 (601 to 648)
<b>NSC3 registration time</b>		
Before “Sure-Win” period	1482 (1463 to 1500)	752 (729 to 776)
Within 30 days since “Sure-Win” period began	1251 (1224 to 1279)	824 (791 to 856)
Over 30 days after “Sure-Win” period began	1187 (1148 to 1226)	857 (813 to 901)
<b>Wearables</b>		
HPB-issued	1507 (1473 to 1540)	703 (662 to 743)
Phone-based	668 (652 to 685)	293 (273 to 314)
Commercial	862 (826 to 899)	536 (491 to 582)
More than one wearable	2121 (2095 to 2147)	1573 (1540 to 1606)
<b>Quartiles of engagement duration (days)</b>		
< 15	445 (404 to 485)	547 (461 to 633)
15-74	826 (798 to 853)	625 (588 to 663)
75-149	1662 (1633 to 1691)	1139 (1105 to 1174)
150-258	1816 (1794 to 1839)	1097 (1071 to 1124)

Data are model estimates of changes in mean daily step count (95% CI). A phase-specific reliable mean daily step count requires at least four days of daily step counts in the corresponding NSC3 phase. Linear mixed effect models with participant-specific intercepts and unstructured within-participant correlation matrix were used. The models adjusted for nationality, sex, age, BMI, registration for previous NSC season, NSC3 registration time, wearable used, and numeric duration of engagement where applicable. For each participant subgroup, a separate model was fitted using data from the corresponding subgroup to estimate the changes. All model estimates had p-value <0.001. NSC: National Steps Challenge; NSC3: NSC Season Three; HPB: Health Promotion Board, Singapore.

**Table S8: NSC3 participant characteristics (N = 539,296) stratified by data availability.**

Characteristics		Total (%)	With at least 1 valid daily step record (%)	With at least 4 daily step records (%)
Total		539,296 (100.0)	421,388 (100.0)	384,691 (100.0)
Nationality	Singapore citizen	349,259 (64.8)	278200 (66.0)	254390 (66.1)
	Noncitizen	190,037 (35.2)	143188 (34.0)	130301 (33.9)
Sex	Female	313,559 (58.1)	246875 (58.6)	226696 (58.9)
	Male	225,737 (41.9)	174513 (41.4)	157995 (41.1)
Age (years)	17-39	270,241 (50.1)	207745 (49.3)	189285 (49.2)
	40-59	207,871 (38.5)	164800 (39.1)	151395 (39.4)
	60-79	58,490 (10.8)	46689 (11.1)	42053 (10.9)
	80+	2,694 (0.5)	2154 (0.5)	1958 (0.5)
Body mass index (kg/m <sup>2</sup> )	<18.5	35,298 (6.5)	27221 (6.5)	24714 (6.4)
	18.5 to <23	224,905 (41.7)	177221 (42.1)	163014 (42.4)
	23 to <27.5	188,251 (34.9)	147653 (35.0)	134690 (35.0)
	>=27.5	90,842 (16.8)	69293 (16.4)	62273 (16.2)
Registration for previous NSC season	No	363,423 (67.4)	272442 (64.7)	240282 (62.5)
	Yes	175,873 (32.6)	148946 (35.3)	144409 (37.5)
NSC3 registration time	Before 'Sure-Win' period	196,832 (36.5)	174207 (41.3)	164373 (42.7)
	Within 30 days since 'Sure-Win' period began	215,571 (40.0)	166471 (39.5)	150809 (39.2)
	Over 30 days after 'Sure-Win' period began	126,893 (23.5)	80710 (19.2)	69509 (18.1)
Wearables	HPB-issued	159,730 (29.6, 37.9**)	159730 (37.9)	140450 (36.5)
	Phone-based	129,402 (24.0, 30.7**)	129402 (30.7)	114855 (29.9)
	Commercial	26,077 (4.8, 6.2**)	26077 (6.2)	24930 (6.5)
	More than one wearable type	106,179 (19.7, 25.2**)	106179 (25.2)	104456 (27.2)
	Not applicable*	117,908 (21.9)	-	-

Data are in N (%). \*No wearable information was available for participants who did not record any valid daily step record. \*\* adjusted % computed using 421,388 as the denominator (the number of participants who provided at least one valid daily step count record). NSC: National Steps Challenge; NSC3: NSC Season Three; HPB: Health Promotion Board, Singapore.

**Table S9: Number of participants who provided step count data on each day of the entire evaluation period according to NSC3 phases.**

Calendar date (The entire evaluation period: from 1 Aug 2017 to 10 Jun 2018)	Number of participants provided daily step count data on each calendar day, according to the NSC3 phases the participants are in.			Total number of participants provided daily step count data on each calendar date
	Baseline monitoring phase	Main challenge phase	Maintenance phase	
1/8/17	24125	0	0	24125
2/8/17	26140	0	0	26140
3/8/17	28041	0	0	28041
4/8/17	29944	0	0	29944
5/8/17	30461	0	0	30461
6/8/17	31054	0	0	31054
7/8/17	32807	0	0	32807
8/8/17	34427	0	0	34427
9/8/17	34002	0	0	34002
10/8/17	36100	0	0	36100
11/8/17	38058	0	0	38058
12/8/17	38164	0	0	38164
13/8/17	38804	0	0	38804
14/8/17	40476	0	0	40476
15/8/17	40770	0	0	40770
16/8/17	41257	0	0	41257
17/8/17	41171	0	0	41171
18/8/17	40984	0	0	40984
19/8/17	39637	0	0	39637
20/8/17	39218	0	0	39218
21/8/17	40218	0	0	40218
22/8/17	40271	0	0	40271
23/8/17	40185	0	0	40185
24/8/17	40028	0	0	40028
25/8/17	40011	0	0	40011
26/8/17	39121	0	0	39121
27/8/17	38760	0	0	38760
28/8/17	39571	0	0	39571
29/8/17	39214	0	0	39214
30/8/17	38766	0	0	38766
31/8/17	38321	0	0	38321
1/9/17	37472	0	0	37472
2/9/17	37794	0	0	37794
3/9/17	37940	0	0	37940
4/9/17	39020	0	0	39020
5/9/17	39260	0	0	39260
6/9/17	39370	0	0	39370
7/9/17	39368	0	0	39368

8/9/17	39354	0	0	39354
9/9/17	38864	0	0	38864
10/9/17	38765	0	0	38765
11/9/17	39681	0	0	39681
12/9/17	40009	0	0	40009
13/9/17	39896	0	0	39896
14/9/17	39804	0	0	39804
15/9/17	39819	0	0	39819
16/9/17	39345	0	0	39345
17/9/17	38987	0	0	38987
18/9/17	39736	0	0	39736
19/9/17	39712	0	0	39712
20/9/17	39587	0	0	39587
21/9/17	41247	0	0	41247
22/9/17	42960	0	0	42960
23/9/17	43385	0	0	43385
24/9/17	44149	0	0	44149
25/9/17	46461	0	0	46461
26/9/17	47228	0	0	47228
27/9/17	48046	0	0	48046
28/9/17	49349	0	0	49349
29/9/17	50349	0	0	50349
30/9/17	51280	0	0	51280
1/10/17	52827	0	0	52827
2/10/17	54060	0	0	54060
3/10/17	54061	0	0	54061
4/10/17	54476	0	0	54476
5/10/17	55474	0	0	55474
6/10/17	57560	0	0	57560
7/10/17	59607	0	0	59607
8/10/17	61561	0	0	61561
9/10/17	63076	0	0	63076
10/10/17	63774	0	0	63774
11/10/17	65259	0	0	65259
12/10/17	66153	0	0	66153
13/10/17	68131	0	0	68131
14/10/17	69176	0	0	69176
15/10/17	70504	0	0	70504
16/10/17	73641	0	0	73641
17/10/17	74996	0	0	74996
18/10/17	73843	0	0	73843
19/10/17	77752	0	0	77752
20/10/17	81600	0	0	81600
21/10/17	86432	0	0	86432
22/10/17	90833	0	0	90833



23/10/17	95888	0	0	95888
24/10/17	99298	0	0	99298
25/10/17	102124	0	0	102124
26/10/17	105285	0	0	105285
27/10/17	112165	0	0	112165
28/10/17	16252	111771	0	128023
29/10/17	15028	119949	0	134977
30/10/17	14504	129458	0	143962
31/10/17	13728	135414	0	149142
1/11/17	12926	139904	0	152830
2/11/17	12312	143799	0	156111
3/11/17	11533	149212	0	160745
4/11/17	10431	151450	0	161881
5/11/17	9642	154486	0	164128
6/11/17	9525	159445	0	168970
7/11/17	9285	162556	0	171841
8/11/17	9023	164592	0	173615
9/11/17	8790	165759	0	174549
10/11/17	8391	167257	0	175648
11/11/17	8092	165626	0	173718
12/11/17	7768	166516	0	174284
13/11/17	7394	174642	0	182036
14/11/17	6867	177557	0	184424
15/11/17	6554	180770	0	187324
16/11/17	6008	182441	0	188449
17/11/17	5476	182990	0	188466
18/11/17	5271	179402	0	184673
19/11/17	5175	178342	0	183517
20/11/17	5111	185196	0	190307
21/11/17	5082	188401	0	193483
22/11/17	4698	190968	0	195666
23/11/17	4374	192078	0	196452
24/11/17	4113	192117	0	196230
25/11/17	3927	188104	0	192031
26/11/17	3709	185848	0	189557
27/11/17	3398	190535	0	193933
28/11/17	2946	190729	0	193675
29/11/17	2686	188817	0	191503
30/11/17	2522	187245	0	189767
1/12/17	2368	184271	0	186639
2/12/17	2263	181932	0	184195
3/12/17	2167	180305	0	182472
4/12/17	2165	185001	0	187166
5/12/17	2093	185374	0	187467
6/12/17	2037	185334	0	187371

7/12/17	1972	185130	0	187102
8/12/17	1956	185569	0	187525
9/12/17	1919	183222	0	185141
10/12/17	1952	181839	0	183791
11/12/17	1915	187391	0	189306
12/12/17	1874	188496	0	190370
13/12/17	1891	190164	0	192055
14/12/17	1876	190866	0	192742
15/12/17	1855	190063	0	191918
16/12/17	1789	186030	0	187819
17/12/17	1708	183599	0	185307
18/12/17	1676	185940	0	187616
19/12/17	1668	185180	0	186848
20/12/17	1610	184922	0	186532
21/12/17	1576	183715	0	185291
22/12/17	1629	183448	0	185077
23/12/17	1641	181160	0	182801
24/12/17	1604	178594	0	180198
25/12/17	1587	177264	0	178851
26/12/17	1620	184365	0	185985
27/12/17	1694	186646	0	188340
28/12/17	1809	187605	0	189414
29/12/17	1881	187997	0	189878
30/12/17	1863	184792	0	186655
31/12/17	1893	181322	0	183215
1/1/18	1998	181978	0	183976
2/1/18	2142	190391	0	192533
3/1/18	2077	191797	0	193874
4/1/18	2025	193688	0	195713
5/1/18	1935	194899	0	196834
6/1/18	1892	190416	0	192308
7/1/18	1876	187027	0	188903
8/1/18	1895	194105	0	196000
9/1/18	1793	197739	0	199532
10/1/18	1679	198443	0	200122
11/1/18	1626	197706	0	199332
12/1/18	1573	196597	0	198170
13/1/18	1559	191646	0	193205
14/1/18	1584	190554	0	192138
15/1/18	1535	201515	0	203050
16/1/18	1517	203015	0	204532
17/1/18	1559	202742	0	204301
18/1/18	1518	204579	0	206097
19/1/18	1468	204124	0	205592
20/1/18	1429	199126	0	200555

21/1/18	1379	196682	0	198061
22/1/18	1363	204091	0	205454
23/1/18	1324	204499	0	205823
24/1/18	1262	204494	0	205756
25/1/18	1284	203645	0	204929
26/1/18	1267	201592	0	202859
27/1/18	1258	197201	0	198459
28/1/18	1250	195119	0	196369
29/1/18	1200	202208	0	203408
30/1/18	1201	202281	0	203482
31/1/18	1163	201929	0	203092
1/2/18	1147	201522	0	202669
2/2/18	1138	199661	0	200799
3/2/18	1109	194821	0	195930
4/2/18	1059	192066	0	193125
5/2/18	1097	196707	0	197804
6/2/18	1047	197390	0	198437
7/2/18	1017	195464	0	196481
8/2/18	951	193583	0	194534
9/2/18	904	190201	0	191105
10/2/18	870	184138	0	185008
11/2/18	813	180077	0	180890
12/2/18	800	183470	0	184270
13/2/18	825	181326	0	182151
14/2/18	866	181802	0	182668
15/2/18	913	178498	0	179411
16/2/18	879	169745	0	170624
17/2/18	918	171466	0	172384
18/2/18	957	174501	0	175458
19/2/18	969	183189	0	184158
20/2/18	954	187831	0	188785
21/2/18	954	188464	0	189418
22/2/18	918	187052	0	187970
23/2/18	903	186522	0	187425
24/2/18	863	182418	0	183281
25/2/18	834	180046	0	180880
26/2/18	799	186979	0	187778
27/2/18	715	186349	0	187064
28/2/18	644	188303	0	188947
1/3/18	635	187920	0	188555
2/3/18	620	186514	0	187134
3/3/18	614	180919	0	181533
4/3/18	609	178403	0	179012
5/3/18	606	184999	0	185605
6/3/18	599	184346	0	184945

7/3/18	611	183257	0	183868
8/3/18	581	180211	0	180792
9/3/18	568	178415	0	178983
10/3/18	554	172842	0	173396
11/3/18	533	169857	0	170390
12/3/18	545	173396	0	173941
13/3/18	499	172849	0	173348
14/3/18	495	171324	0	171819
15/3/18	513	169927	0	170440
16/3/18	522	169329	0	169851
17/3/18	523	165701	0	166224
18/3/18	527	163887	0	164414
19/3/18	520	169455	0	169975
20/3/18	513	169093	0	169606
21/3/18	505	169413	0	169918
22/3/18	460	168405	0	168865
23/3/18	437	167136	0	167573
24/3/18	429	162182	0	162611
25/3/18	401	158622	0	159023
26/3/18	382	163570	0	163952
27/3/18	364	162843	0	163207
28/3/18	349	161925	0	162274
29/3/18	340	159570	0	159910
30/3/18	326	153148	0	153474
31/3/18	313	151738	0	152051
1/4/18	317	0	148164	148481
2/4/18	324	0	152854	153178
3/4/18	318	0	152304	152622
4/4/18	306	0	151298	151604
5/4/18	297	0	148986	149283
6/4/18	289	0	146696	146985
7/4/18	287	0	140486	140773
8/4/18	262	0	137576	137838
9/4/18	248	0	140898	141146
10/4/18	234	0	141441	141675
11/4/18	209	0	139556	139765
12/4/18	188	0	136691	136879
13/4/18	179	0	134113	134292
14/4/18	140	0	127506	127646
15/4/18	115	0	122523	122638
16/4/18	107	0	124712	124819
17/4/18	90	0	120622	120712
18/4/18	81	0	114857	114938
19/4/18	100	0	114453	114553
20/4/18	104	0	114432	114536

21/4/18	122	0	111759	111881
22/4/18	134	0	111647	111781
23/4/18	123	0	121161	121284
24/4/18	112	0	125428	125540
25/4/18	101	0	126022	126123
26/4/18	73	0	125417	125490
27/4/18	60	0	124326	124386
28/4/18	22	0	120626	120648
29/4/18	0	0	118392	118392
30/4/18	0	0	120270	120270
1/5/18	0	0	105177	105177
2/5/18	0	0	103335	103335
3/5/18	0	0	100438	100438
4/5/18	0	0	98841	98841
5/5/18	0	0	94668	94668
6/5/18	0	0	91787	91787
7/5/18	0	0	94239	94239
8/5/18	0	0	94215	94215
9/5/18	0	0	93238	93238
10/5/18	0	0	92186	92186
11/5/18	0	0	91129	91129
12/5/18	0	0	87282	87282
13/5/18	0	0	85283	85283
14/5/18	0	0	88640	88640
15/5/18	0	0	87809	87809
16/5/18	0	0	85660	85660
17/5/18	0	0	85585	85585
18/5/18	0	0	84866	84866
19/5/18	0	0	81945	81945
20/5/18	0	0	79941	79941
21/5/18	0	0	82230	82230
22/5/18	0	0	82039	82039
23/5/18	0	0	82410	82410
24/5/18	0	0	82602	82602
25/5/18	0	0	82456	82456
26/5/18	0	0	83646	83646
27/5/18	0	0	84682	84682
28/5/18	0	0	88115	88115
29/5/18	0	0	85417	85417
30/5/18	0	0	87521	87521
31/5/18	0	0	85580	85580
1/6/18	0	0	83105	83105
2/6/18	0	0	76574	76574
3/6/18	0	0	70950	70950
4/6/18	0	0	68418	68418

5/6/18	0	0	62439	62439
6/6/18	0	0	56907	56907
7/6/18	0	0	50913	50913
8/6/18	0	0	42901	42901
9/6/18	0	0	29773	29773
10/6/18	0	0	8074	8074