A Probability State Transition Matrix can be Used to Estimate Weight Loss for Individuals with Overweight or Obesity Enrolled in an AI-enabled Digital Health Weight Management Program"

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OBJECTIVE

We studied probabilities of weight loss, stratified by starting body mass index (BMI) band, for users of an AI-enabled digital health tool supporting weight loss. We hypothesized that not all BMI "shifts" were equal, and that by fractionalizing BMI shift by incremental BMI loss and starting BMI, we could establish a weight loss probability state transition matrix to estimate future weight loss for individuals using the digital health tool with and without an anti-obesity medication (AOM).

METHOD

The data is based on users of a digital health platform who were enrolled in a weight management program. The data were deidentified according to Welldoc's privacy policies and were stratified by starting BMI values. Only individuals who recorded weight at baseline, 3 months, and 6 months were included in the analysis (N=4759).

RESULT

We identified 3604 users prescribed AOMs and 1155 users not prescribed AOMs. Users were stratified into starting BMI bands: <27, 27-29, 30-32, 33-35, 36-40, >40. The percent movement from each starting band to each ending band was tabulated to formulate the probability state transition matrix. BMI improved significantly in both cohorts, but the probability state transition matrices differed in a statistically significant manner. In general, for users with starting BMI <36, use of the digital health tool proved to be an effective mechanism to lose weight without an AOM.

Figure 1: Population demographics

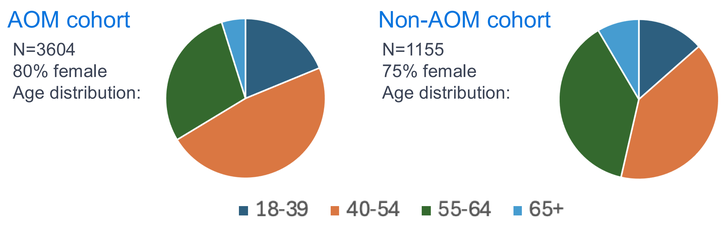

Figure 2: Weight outcome summary: stacked bar view

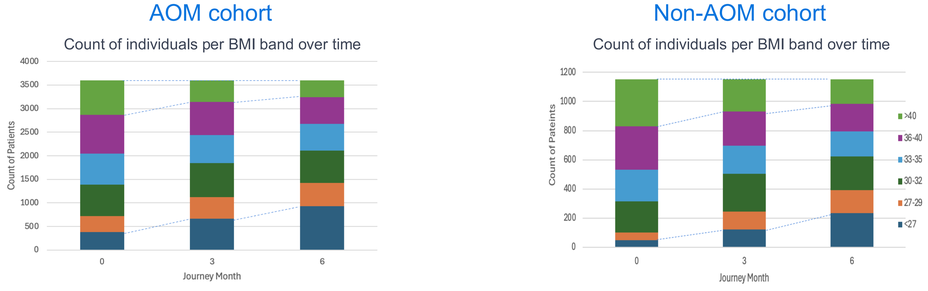

Table 1: State Transition Matrix - AOM

Baseline	Endline = 6 Months					
BMI Band	<27	27-29	30-32	33-35	36-40	>40
<27	0.89	0.06	0.02	0.01	0.02	0.00
27-29	0.66	0.27	0.05	0.01	0.00	0.00
30-32	0.36	0.33	0.26	0.03	0.00	0.00
33-35	0.13	0.18	0.44	0.22	0.03	0.00
36-40	0.04	0.05	0.19	0.38	0.33	0.01
>40	0.01	0.01	0.02	0.09	0.38	0.49

Table 2: State Transition Matrix – Non- AOM

Baseline	Endline = 6 Months					
BMI Band	<27	27-29	30-32	33-35	36-40	>40
<27	0.88	0.10	0.00	0.00	0.02	0.00
27-29	0.72	0.22	0.04	0.01	0.00	0.00
30-32	0.44	0.25	0.28	0.04	0.00	0.00
33-35	0.16	0.28	0.39	0.16	0.02	0.00
36-40	0.02	0.06	0.27	0.35	0.28	0.01
>40	0.01	0.00	0.04	0.09	0.31	0.55

Looking at trends across Table 1 and Table 2 above, after six months, the data reveals clear patterns in BMI changes. Individuals at the extreme ends of the spectrum, in the <27 (healthy/underweight) and >40 (severe obesity) BMI bands, exhibited the highest stability, showing a strong tendency to remain in their original category. Conversely, the middle BMI bands (e.g., 27-29, 30-32, 33-35) were the most "in flux," displaying the lowest probability of staying in the same band. Most notably, individuals starting in these overweight and obese middle categories demonstrated a very strong probability of decreasing their BMI, with a high likelihood of successfully moving into a lower BMI category within the 6-month period

CONCLUSION

A probability state transition matrix was developed to estimate the weight loss effect of the digital health tool, with and without AOM, specifically considering the impact across BMI bands. These data, when combined with engagement patterns (as detailed in a companion abstract) is foundational to development of AI-based weight loss prediction capabilities, based on both starting BMI level and the level of digital health engagement. Further research into segmented engagement patterns and needs (by AOM status and BMI band) is essential to fully realize personalized weight management strategies supported by AI-driven digital health tools..