

# Modelling of UK General Population Utility: The ALDVMM Approach in Practice

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## Introduction

- NICE Decision Support Unit (DSU) recently published a report on age and sex-adjusted general population utility in the UK.<sup>1</sup> This identified the need for models of how utilities change with age.
- DSU fitted a three-component adjusted limited dependent variable mixture model (ALDVMM) to the EQ-5D 3L data from the Health Survey for England (HSE) 2014 dataset.<sup>1</sup>
- ALDVMM addresses distributional features and skewness of the EQ-5D but is significantly more complex than OLS models in terms of implementation.<sup>2</sup>
- Other published studies have explored different approaches to model general population utility, such as the ordinary least squares (OLS) model by Ara and Brazier (2010).<sup>3</sup>
- It is unclear the strengths and limitations of ALDVMM and OLS in practice when implementing these approaches in economic models.

## Objective

Our research aimed to:

- Compare the ALDVMM approach against an OLS approach in estimating general population utility as a function of age and sex.
- Compare the performance of ALDVMM and OLS models using EQ-5D 3L data from HSE 2014 as well as larger samples from HSE 2003 – 2014 datasets.

## Methods

- The analysis used EQ-5D 3L data from HSE datasets, accessed via UK Data Service.
- All HSE datasets reporting EQ-5D 3L were included in this analysis: HSE 2003-2006, 2008, 2010-2012 and 2014.
- The analysis was conducted in STATA version 17.
- DSU's 3-component ALDVMM analysis was repeated using HSE 2014 data and using HSE 2003-2014 datasets.
- OLS analysis was based on the model developed by Ara and Brazier (2010)<sup>3</sup>; however, the sex variable was excluded.
- All analyses were conducted for male and female separately.
- We tested each model in probabilistic sensitivity analysis (PSA) using 5,000 Monte Carlo simulations.
- Expected EQ-5D 3L utilities based on ALDVMM and OLS models are compared against the observed EQ-5D 3L mean utilities in the HSE datasets.

## Results

- Neither ALDVMM nor OLS models predicted utilities outside of -0.594 to 1 range in people aged 16+.
- Figure 1** and **Figure 2** show that the ALDVMM and OLS predicted EQ-5D 3L utilities are aligned with the observed utilities from HSE datasets, with greater variation among older age groups. The precision of predictions improves in the analysis with HSE 2003-2014 datasets.
- The predicted EQ-5D 3L utilities by age in ALDVMM and OLS models are very similar, as shown in **Figure 3** and **Figure 4**. Predicted EQ-5D 3L values are slightly lower in the HSE 2003-2014 analysis than the HSE 2014 analysis.
- Table 1** presents the mean difference between predicted and observed utilities, indicating that the ALDVMM and OLS models are closely aligned across all analyses.
- Table 2** compares the performance of ALDVMM and OLS models using 5,000 Monte Carlo simulations, reporting % of sample which are  $\geq 20\%$  above or below the deterministic predicted EQ-5D 3L utilities or the observed EQ-5D 3L utilities in the HSE datasets.
- Overall, majority of the probabilistic utilities are within the  $\pm 20\%$  range of the deterministic mean utilities. **Figure 5** and **Figure 6** show that there are more probabilistic samples in the ALDVMM analysis fall outside of the  $\pm 20\%$  range than the OLS models, particularly among the older age groups.

**Table 1. Mean prediction error of models\***

	Model	N	Mean	SD	Min	Max
HSE 2014 analysis	ALDVMM male	3,111	-0.0031	0.2168	-1.4835	0.2705
	OLS male	3,111	-0.0030	0.2168	-1.4811	0.2547
	ALDVMM female	3,974	-0.0008	0.2317	-1.4594	0.3483
	OLS female	3,974	-0.0008	0.2318	-1.4586	0.3279
HSE 2003-14 analysis	ALDVMM male	39,776	0.0011	0.2162	-1.4764	0.3097
	OLS male	39,776	0.0011	0.2161	-1.4736	0.3135
	ALDVMM female	50,222	-0.0016	0.2292	-1.5362	0.3780
	OLS female	50,222	-0.0015	0.2291	-1.5368	0.4006

Note: \* difference between EQ-5D 3L utility prediction and observation; ALDVMM, adjusted limited dependent variable mixture model; HSE, Health Survey for England; Max, maximum; Min, minimum; N, number; OLS, ordinary least squares; SD, standard deviation.

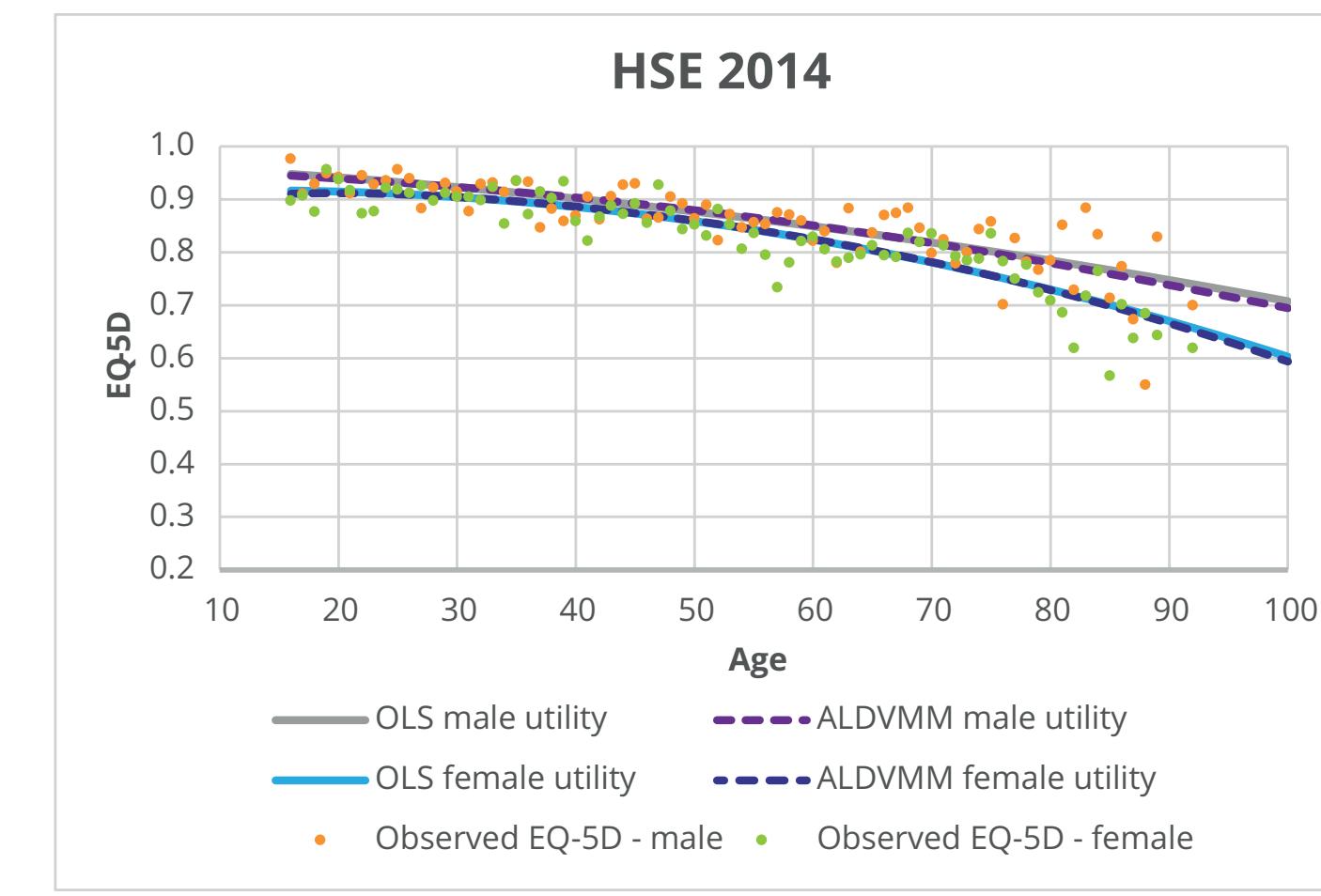
**Table 2. Comparisons of ALDVMM and OLS models using 5,000 Monte Carlo simulations**

	ALDVMM male	OLS male	ALDVMM female	OLS female
% if probabilistic sample is $\geq 20\%$ above deterministic predicted utility	HSE 2014 analysis	0.00%	0.00%	0.00%
	HSE 2003-14 analysis	0.00%	0.00%	0.00%
% if probabilistic sample is $\geq 20\%$ below deterministic predicted utility	HSE 2014 analysis	0.47%	0.00%	0.17%
	HSE 2003-14 analysis	0.02%	0.00%	0.00%
% if probabilistic sample is $\geq 20\%$ above observed mean EQ-5D 3L in HSE	HSE 2014 analysis	1.14%	1.18%	0.93%
	HSE 2003-14 analysis	2.58%	2.52%	3.47%
% if probabilistic sample is $\geq 20\%$ below observed mean EQ-5D 3L in HSE	HSE 2014 analysis	0.21%	0.00%	0.01%
	HSE 2003-14 analysis	0.72%	0.93%	0.00%

Note: ALDVMM, adjusted limited dependent variable mixture model; HSE, Health Survey for England; OLS, ordinary least squares.

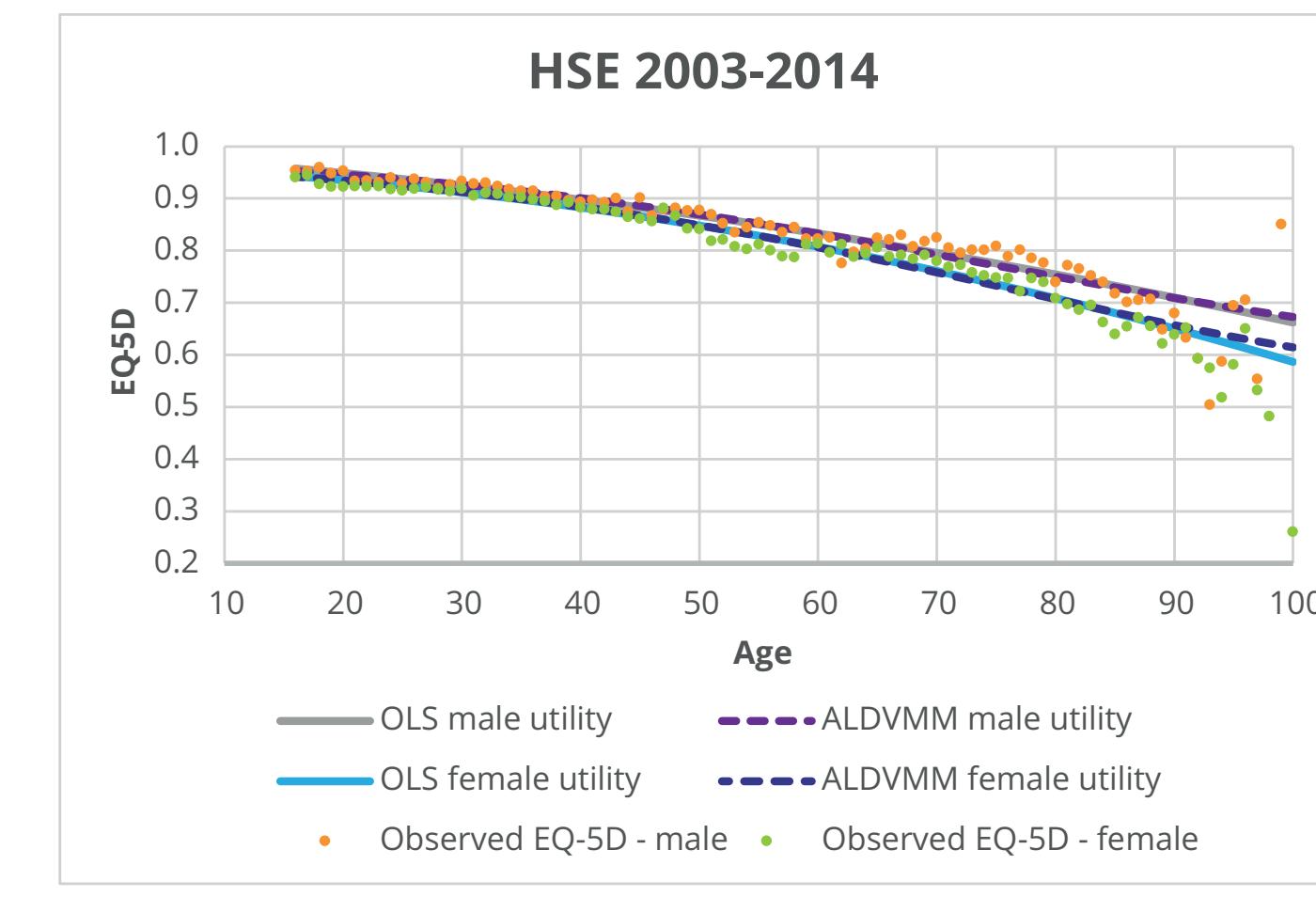
## Results (Cont'd)

**Figure 1. Comparison of observation and predicted utility based on ALDVMM and OLS models - HSE 2014**



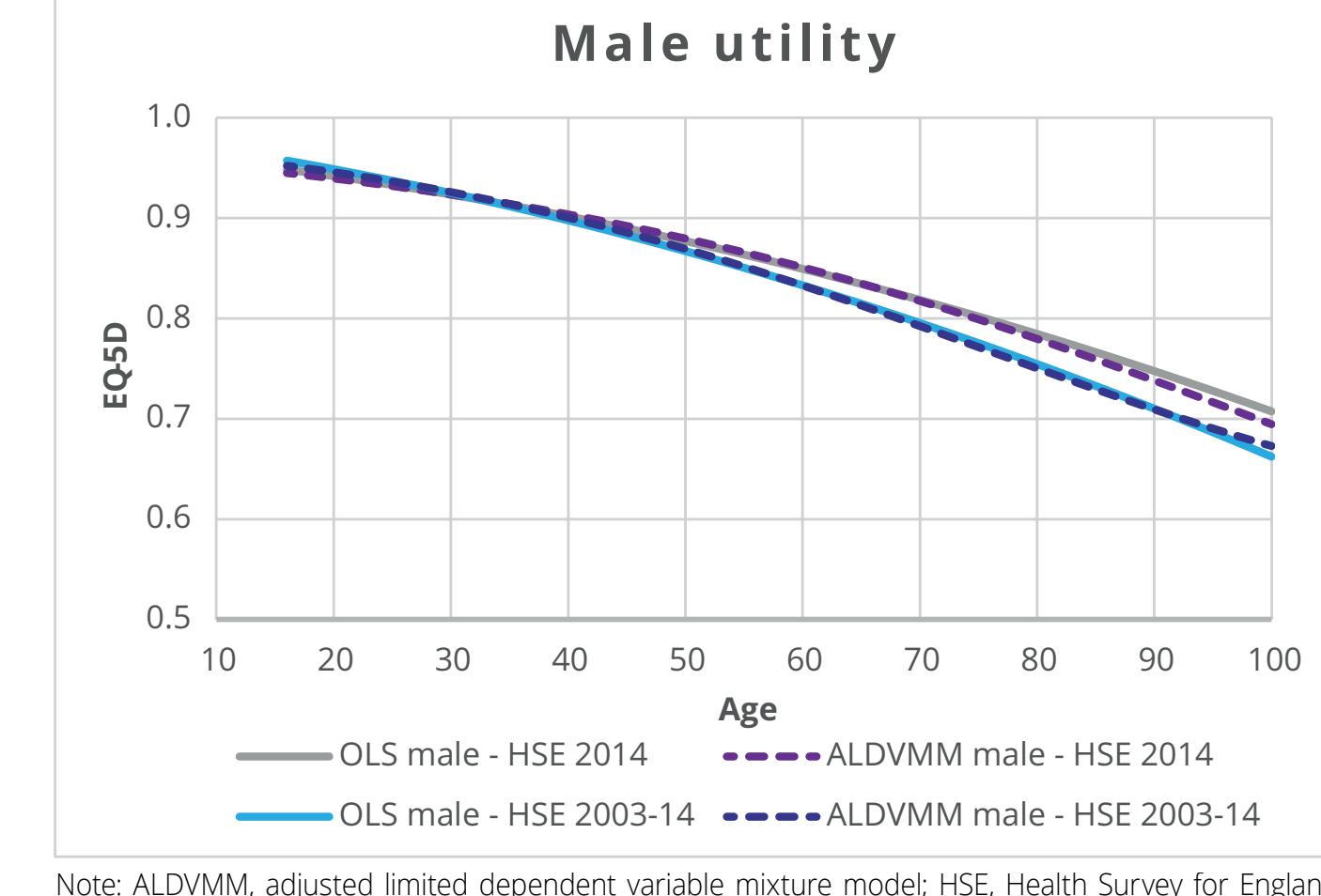
Note: ALDVMM, adjusted limited dependent variable mixture model; HSE, Health Survey for England; OLS, ordinary least squares. HSE 2014 OLS models: OLS male: utility = 0.96913771 - 0.0107164\* age - 0.0001546\* age^2; OLS female: utility = 0.91067203 + 0.00099904\* age - 0.00004080\* age^2.

**Figure 2. Comparison of observation and predicted utility based on ALDVMM and OLS models - HSE 2003 - 2014**



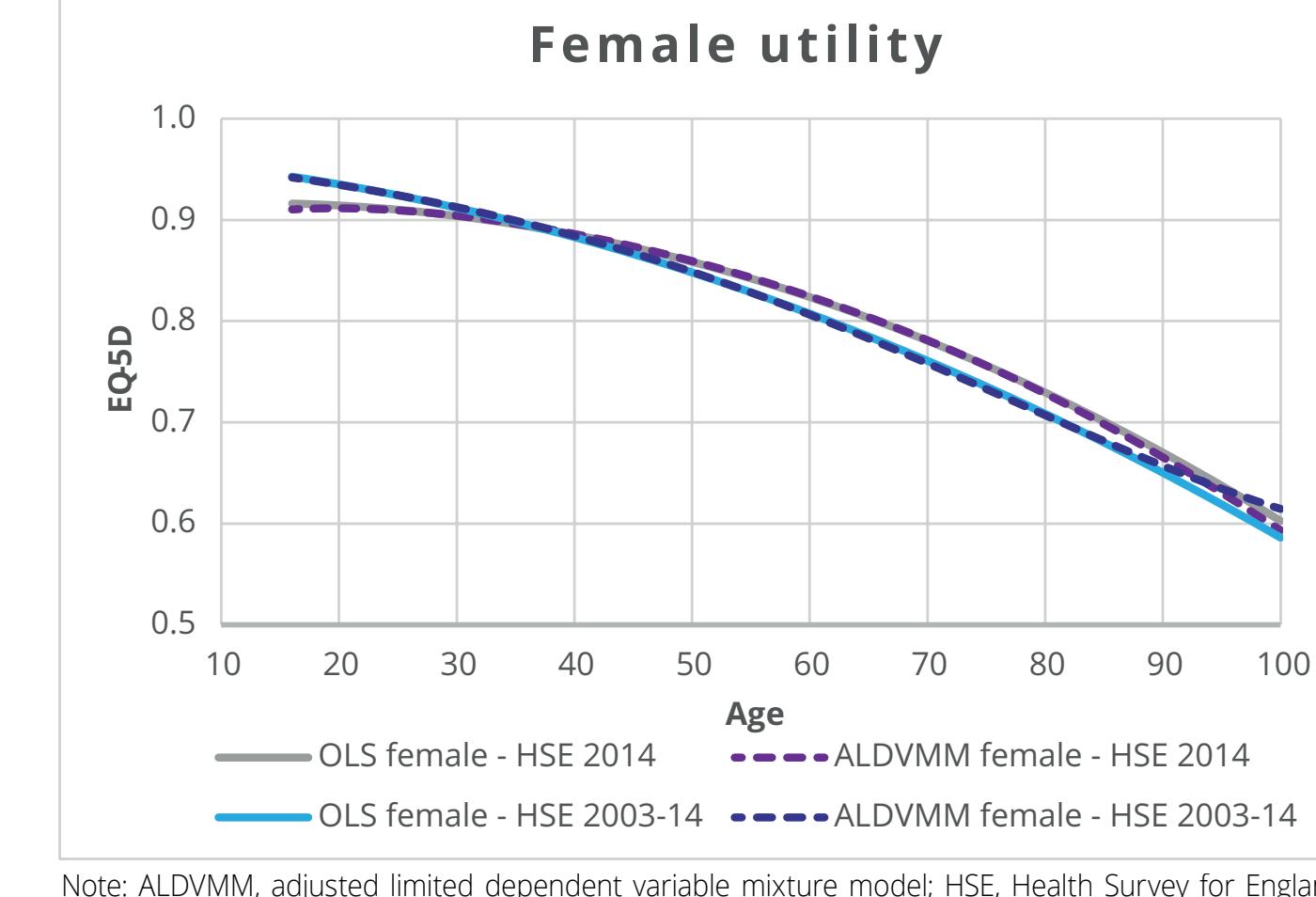
Note: ALDVMM, adjusted limited dependent variable mixture model; HSE, Health Survey for England; OLS, ordinary least squares. HSE 2003-14 OLS models: OLS male: utility = 0.98573887 - 0.00151825\* age - 0.00001717\* age^2; OLS female: utility = 0.96407500 - 0.00085949\* age - 0.00002920\* age^2.

**Figure 3. Comparison of predicted utility based on ALDVMM and OLS models - male**



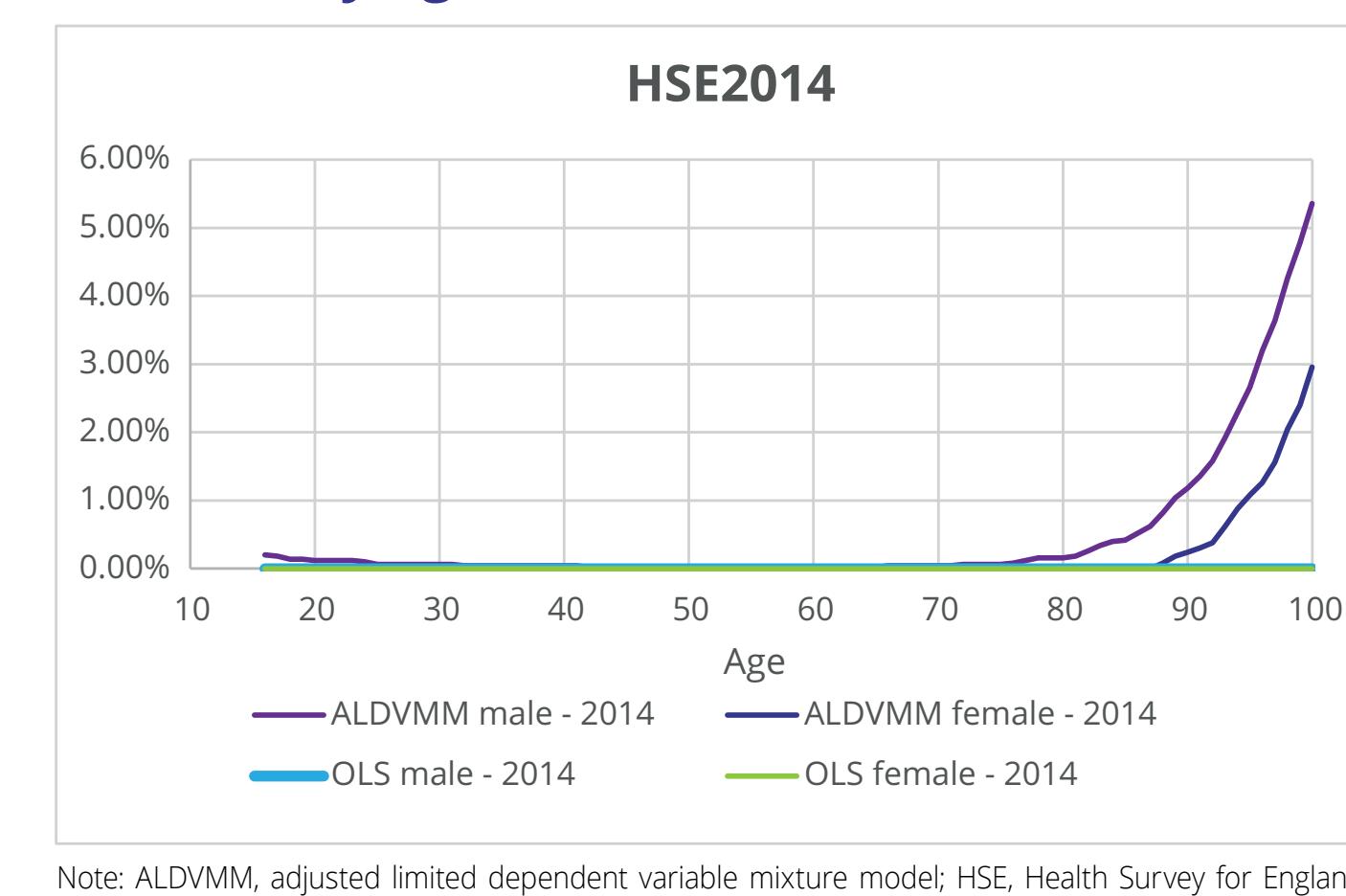
Note: ALDVMM, adjusted limited dependent variable mixture model; HSE, Health Survey for England; OLS, ordinary least squares.

**Figure 4. Comparison of predicted utility based on ALDVMM and OLS models - female**



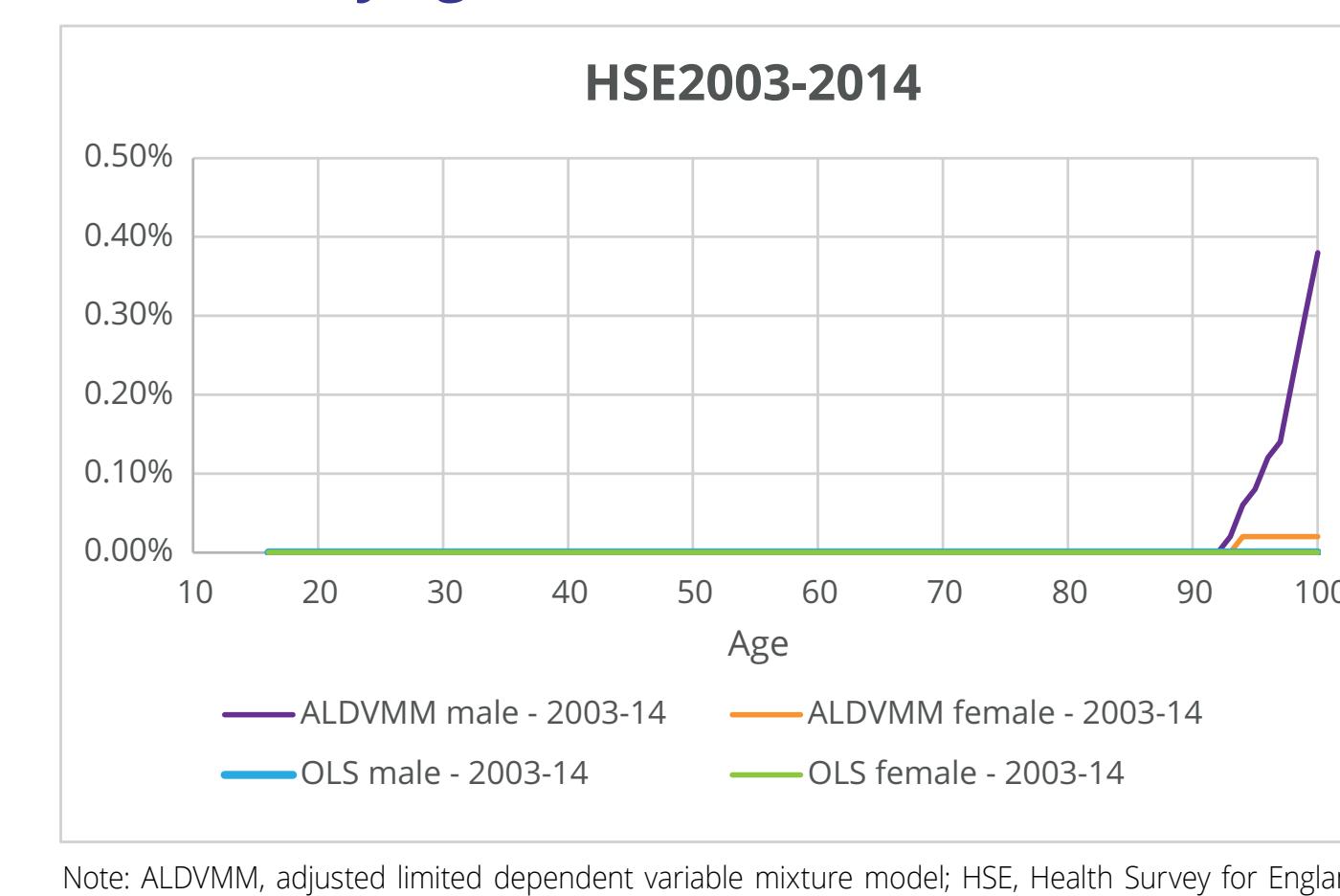
Note: ALDVMM, adjusted limited dependent variable mixture model; HSE, Health Survey for England; OLS, ordinary least squares.

**Figure 5. % if probabilistic sample is  $\geq 20\%$  below predicted EQ-5D 3L utility, by age - HSE 2014**



Note: ALDVMM, adjusted limited dependent variable mixture model; HSE, Health Survey for England; OLS, ordinary least squares.

**Figure 6. % if probabilistic sample is  $\geq 20\%$  below predicted EQ-5D 3L utility, by age - HSE 2003-2014**



Note: ALDVMM, adjusted limited dependent variable mixture model; HSE, Health Survey for England; OLS, ordinary least squares.

## Conclusions

- OLS models generate very similar results to ALDVMM models when predicting mean EQ-5D 3L utilities for UK general population.
- Analysis with larger datasets improves the prediction.
- The variations in predicted mean EQ-5D 3L utilities are more prominent among the older age groups. There are more probabilistic samples in the ALDVMM analysis fall outside of the  $\pm 20\%$  range of the deterministic mean utilities.
- Given the complexity of implementing ALDVMM models in economic models, OLS models may serve as an alternative to predict EQ-5D 3L utilities for UK general population.

## References

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