Impact case study (REF3)

Institution: University of Plymouth

Unit of Assessment: UoA10

Title of case study: Improved health research and practice through advancing statistical methods and applications

Period when the underpinning research was undertaken: 2012 - present

Details of staff conducting the underpinning research from the submitting unit:

<table>
<thead>
<tr>
<th>Name(s):</th>
<th>Role(s) (e.g. job title):</th>
<th>Period(s) employed by submitting HEI:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr Yinghui Wei</td>
<td>Associate Professor of Statistics</td>
<td>2013 – present</td>
</tr>
<tr>
<td>Dr Malgorzata Wojtys</td>
<td>Lecturer in Statistics</td>
<td>2013 – present</td>
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</tbody>
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Period when the claimed impact occurred: 2015 – 31.12.20

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact (indicative maximum 100 words)

Dr Yinghui Wei’s research on novel medical statistics has:

1) Provided information through a Cochrane review on the significance of cutting portion size which informed Public Health England’s sugar reduction report. Moreover, it raised public awareness of the importance of portion size and led to it becoming a key principle of weight management. Internationally, it informed the World Health Organization and Australia’s Victorian Health Promotion Agency.

2) Created a statistical package which significantly reduces the time, resources required, and costs of individual participant survival data collection.

3) Produced a statistical analysis which has enabled kidney transplant doctors to understand the change of survival benefit of transplants over time, assisted with decision-making about treatment options in their clinical practice and enabled doctors to communicate better with their patients.

2. Underpinning research (indicative maximum 500 words)

Research led by Dr Yinghui Wei at the University of Plymouth (UoP) in collaboration with colleagues from University Hospitals Plymouth NHS Trust, UCL, and Universities of Cambridge, Nottingham and Bristol, has focused on the following themes.

a) Statistical analysis in evidence synthesis

The Cochrane sizing review [3.1] suggested that cutting portion, packaging and tableware size presented a potential path to tackle obesity, which impacts a quarter of British adults, costing lives and quality of life. Wei co-led the statistical analysis in this review to evaluate the effect of portion, package, individual unit and tableware size on changing the consumption of food, alcohol and tobacco [3.1]. She conducted a meta-analysis of 86 independent comparisons from 58 studies (6,603 participants), which concluded a statistically significant effect of portion, package, individual unit or table size on food consumption (standardised mean difference, 0.38, 95% CI: 0.29 to 0.46), providing evidence that exposure to larger sizes increases quantities of food consumption, regardless of factors such as gender and BMI.
Other statistical analysis research included a network meta-analysis in [3.2], which allowed the simultaneous evaluation of eight different treatment options for patients with localised prostate cancer, by combining results from 21 randomised trials that included 3,450 men. Wei and collaborators also implemented stochastic transmission models and combined the results across multiple wards in intensive care units in an US hospital to evaluate the control measures consisting of gown and glove as well as isolation room management in minimising the spread of antimicrobial-resistant pathogens [3.3].

b) Regenerating individual level time-to-event data for health technology assessments
Meta-analysis plays a central role in health technology assessments. Individual participant data (IPD) meta-analysis is a gold standard of systematic reviews. However, collecting IPD from multiple studies is time consuming, and often takes months to years, with inevitable funding implications.

Wei led the development of the statistical package ipdfc in Stata [3.4], which enables the accurate regeneration of the individual participant time-to-event data by using the information extracted from published survival or cumulative incidence curves. The regenerated data can be used to estimate hazard ratios as well as conduct secondary analyses, and hence enable the best use of the available evidence for health technology assessments.

c) Survival analysis in kidney transplant
Since 2015, Wei conducted statistical analysis for the annual reports of the South West Transplant Centre (SWTC). Wei estimated the difference in restricted mean survival time (RMST) [3.5] between living and deceased donor recipient groups for kidney graft survival and overall patient survival, respectively. The difference in RMST between treatment groups gives an interpretation of the gain/loss in life expectancy in any defined unit measurement of time. Her team extended copula models [3.6] to survival analysis to estimate the correlation coefficient between kidney graft failure and death, which gives an insight into the strength and direction of the association. They also applied these novel methods to the transplant national database from NHS Blood and Transplant (NHSBT). Since data from multiple transplant units are available, the results of the difference in RMST are combined using statistical methods described in [3.5]. This ongoing collaboration with the SWTC has resulted in them providing funding for a PhD project to develop risk prediction models to assist clinical decision making in kidney transplant.

3. References to the research (indicative maximum of six references)


### Research Grants

We have secured research grants totalling over £332K as detailed below, to establish our medical statistics research.


(2019 – 18 months) **Wei Y.**, Co-I, GSK, “An assessment of the sensitivity to change of a scale to measure quality of life in patients with severe asthma”, PI: Jones R. at the University of Plymouth, £55,754.

(2019 – 12 months) **Wei Y.**, Co-I, GSK, “Further validation of a scale to measure quality of life in patients with severe asthma”, PI: Jones R. at the University of Plymouth, £44,503.


### 4. Details of the impact (indicative maximum 750 words)

#### a) Government policy change in food and drink sectors

Obesity has become one of the major challenges of our time. It is a complex condition, with significant contributions from genetic factors, physiological factors, environmental factors, and social and psychological factors that influence diet and activity. About two thirds of UK adults are now overweight and nearly one third are obese. Obesity alone accounts for at least 10% of NHS spend, and this is rising. Therefore, the prevention and treatment of obesity has become a national priority. In the UK, NICE guidance “Obesity: Identification assessment, management” identified the broad principles of dietary (and other) treatments, including the aim of achieving an energy deficit while maintaining a healthy and balanced diet. However, the guidance did not provide detailed guidance on how this can be achieved.

Wei and colleagues Cochrane sizing review and meta-analysis rectified this problem by providing important evidence demonstrating that reducing the size of food portions and tableware can be used as a strategy for weight loss. The review was cited in Public Health England’s (PHE) October 2015 publication *Sugar reduction: The evidence for action* report [5.1], which had been commissioned by the Department of Health to feed into the Government’s childhood obesity strategy. PHE’s report highlighted Wei’s review to argue for the benefits of reducing portion sizes. This was then used to create a programme of gradual sugar reduction in food and drink combined with the reduction in portion size and led to the development of various tools such as the Eatwell Guide, that assist patients in achieving weight loss. [Wei’s] evidence-based strategy has become a key principle of weight management and is now firmly embedded within weight management programmes such as ours, and elsewhere in the UK and worldwide’. Professor Jonathan Pinkney, Consultant Physician, Plymouth and West Devon Weight Management Service, Livewell South West [5.2].

Wei’s research raised public awareness on portion size and regularly receives media attention in news and television programmes 5.3. This has resulted in the concept of portion control being universally recognised as a fundamental requirement for the prevention of weight gain and its associated health comorbidities, and for achieving weight loss. This is evidenced by a wide range of websites, both nationally and internationally, who use this strategy (e.g., British Heart Foundation, the British Nutrition Foundation and the British Dietetic Association) [5.2].

Internationally, the World Health Organization e-library of Evidence for Nutrition Actions quoted Wei’s review to argue for “limiting portion sizes to reduce the risk of childhood overweight and obesity”[5.4]. Moreover, the findings of the review were shared with Australia’s Victorian Health Promotion Agency (VicHealth) [5.5] and used in their subsequent citizen jury which resulted in a recommendation that beverage sizes should be regulated and that a maximum size of soft drinks and other calorie-dense beverages that can be sold through restaurants and retail outlets should be imposed.
b) Saving time and costs in data collection and analysis

Individual participant data (IPD) meta-analysis is a quantitative method in evidence synthesis using the original research data sought directly from the researchers responsible for each study. This collection of individual raw data is time intensive (often taking months to years), usually requires dedicated staff with a variety of skills and it costs more than a conventional meta-analysis of published or other summary data. Wei’s innovative statistical package *ipdfc*[^34] used published curves to generate individual participant data which reduced the time of data collection and at no cost. As of November 2020, the package has been downloaded more than 153 times from the *Stata Journal*[^56], with users in the UK, USA, China, Spain, France, Netherlands, India, Singapore and Switzerland.

A bioinformatician from Switzerland confirmed that Wei’s package provides a significant benefit in its simplicity in implementation and accuracy on extrapolating individual-level data. This statistical package can potentially help clinicians with decision making for health technology assessments by estimating statistical robustness of trials, evaluating the benefit of treatments, and enhancing communication with patients[^57]. [text removed for publication], says, ‘I would like to emphasize that ‘ipdfc’ is exceptionally accurate in our experience…. In summary, using your statistical package has provided me with significant benefits. It has enabled [us] to reduce the time of data collection from months and years to a few minutes and at zero financial cost.’[^57].

A Spanish hospital confirmed that Wei’s package has enabled their team to reconstruct a database for five studies of 4,686 patients, producing evidence of the long-term survival benefit of a mechanical valve compared to biological aortic valve replacement in patients with heart diseases. Their previous methodology frequently produced incorrect conclusions and Wei’s package enabled them to strengthen their methodology. The calculation has allowed them to understand which group has a lower risk of death. *The package has contributed to producing reliable information which we are confident in, and I found it is more accurate than the other packages for regenerating the original survival data. Your work has been very beneficial… allowing us to increase our understanding of the research questions. The package has informed and benefitted our research practice enabling us to perform alternative statistical analyses*: [text removed for publication][^58].

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In 2019, Wei and her team presented their RMST application at the SWTC annual transplant day. This day is approved as Continuing Professional Development by the Royal College of Physicians. The event was attended by 57 participants (22 doctors, 15 nurses, 14 statisticians, 4 biomedical scientists, one pharmacist and one lay person). A UoP commissioned independent evaluation of the event confirmed that doctors find Wei’s application valuable. One doctor said, “As a clinician, I feel that RMST is very intuitive and easier to explain/more relevant to patients/practice”. Seventy-one percent of doctors said that the use of RMST had enabled them to explain years/months gain/loss in life expectancy since transplant and 67% found RMST easier to understand than the hazard ratio. Visualisation of the difference in RMST helped

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[^34]: ipdfc
[^56]: Stata Journal
[^57]: text removed for publication
[^58]: text removed for publication
doctors to understand the change of survival benefit of transplants over time (71%), and 42% of doctors reported the RMST assisted with decision-making about treatment options in their clinical practice. [text removed for publication] said “Your presentation… received extremely positive feedback. Of the participants that responded, 92% said that they found it useful.” [5.9].

5. Sources to corroborate the impact (indicative maximum of 10 references)

5.2 Testimonial Professor Jonathan Pinkney BSc MB BS, MD FRCP Consultant Physician, Plymouth and West Devon Weight Management Service, Livewell South West, Plymouth.
5.3 NHS Choices, Decreasing portion sizes could cut obesity levels, 2015.
5.4 WHO e-Library of Evidence for Nutrition Actions, Limiting portion sizes to reduce the risk of childhood overweight and obesity, 2019.
5.5 The Cochrane Review on portion sizes - from publication to informing policy https://www.cochrane.org/news/cochrane-review-portion-sizes-publication-informing-policy
5.6 Email from the Stata Journal Production Manager, 2020.
5.7 Testimonial [text removed for publication].
5.8 Testimonial [text removed for publication] 2019.
5.9 Testimonial [text removed for publication] 2019.
5.10 Testimonial [text removed for publication], 2019.