of “town women” and finally “college women” and published a pioneering time use estimates of the economic value of US women’s homemaking activity based on the USDA materials [9].

The first major US academic study of the time use of both men and women, *(*which explicitly identified Kneeland’s USDA work as the source of its methodology) was

Table 1 MTUS: N of diary days for historical cross-national comparative research on time use patterns

Country	1961–6	1971–5	1979–81	1983–7	1989–92	1995–99	1999–04	2005–09	2010–15	Country Totals
Austria					25,233					25,233
Australia		1491		3181	13,806	14,315		13,617		46,410
Belgium	2085									2085
Bulgaria	2096									2096
Canada		2138	8727	9618	25,233	10,726		19,597	15,390	91,429
Czech Rep	2211									2211
Germany	5078				25,812		35,813			66,703
Denmark	4174			3561			6617			14,352
Spain							51,813	19,295		71,108
Finland			12,038	15,184		10,074		7480		44,776
France	2791	4634				15,441		27,903		50,769
Hungary								8391		8391
Israel					4843					4843
Italy			2118		38,110		51,206	40,940		132,374
S Korea						85,906		40,526		126,432
Neth'lnd		9163	19,110	22,841	23,905	22,589	12,691	15,428		125,727
Norway		6516	6066		6129		7669			26,380
Peru	777									777
Poland	2740						40,292		76,656	119,688
Serbia	1993									1993
Sweden					7065		7727			14,792
Slovenia	2120						12,276			14,396
UK	9292	20,252		16,316			20,982		13,538	80,380
US	2017	7088		3339			34,693	64,085	38,182	149,404
S Africa							14,302			14,302
Year totals	37,374	51,282	48,059	74,040	170,136	159,051	296,081	257,262	143,766	1,237,051

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are around 0.58, and range from 0.45–0,69 for moderate-vigorous physical activity, higher than the usual coefficients between self report and objectively assessed activity [2].

Time e and i blic heal h ـe ea ـch o en ial

Time use surveys are a valuable resource for public health researchers (i) as they provide comprehensive coverage of all activities during the 24 h day and (ii) their long history, national representativeness and largely standardised form, facilitates epidemiological research into cross national comparisons and trend analyses over time. Time use data have been used to describe physical activity patterns, mental health states, and trends in nutrition that are relevant to public health. In addition, socio-economic inequalities in these health attributes, as well as more broadly in society, can also be gleaned from trend analyses. However, the range of potential applications has not been thoroughly explored in these public health contexts.

With respect to physical activity, TUDs capture the spectrum of activity, including moderate-vigorous time, through light intensity activity, to sedentary (sitting) time and time spent in sleep, summating to the 24 h day. This brings a comprehensive dimension to energy expenditure research, using comparable TUDs over decades, compared to frequent changes to physical activity self-report surveillance measures. Further, TUDs provide unique contextual and domain specificity for physical activity behaviours, attributes that are not easily measured in objective monitoring. Validation work around TUDs against objective measurement with accelerometry indicate that TUDs show higher validity coefficients than almost all other self-reported physical activity measures [2], and additionally, provide information about the social and environmental contexts in which activities occur. TUD information has been used to profile physical activity

and sport participation patterns within countries [18–21] and over time [20, 22]. Efforts have commenced to harmonise TUD information against the physical activity compendia, better classifying activities by their energy expenditure [21].

Other aspects of physical activity can also be studied using time use data. The burgeoning of passive transport and car dependency has occurred at different rates across countries, which can be studied using time use data. Similarly, workplaces have become automated, with major increases in sedentary and light intensity activities at work over the past six decades [23]. Time use data also demonstrate the major contributions of walking to reaching recommended levels of physical activity [18]. Further, the effects of urban planning on car use, as opposed to walking, become obvious in examining time use surveys. A comparison of Australian households showed that people in households that did not have a car walked on average 15 min day, whereas those households with one car walked about 8 min a day, and those with 2+ cars walked 4 min a day or less. This allows the study of the effects of "automobilization" and of transport policies on physical activity levels over time and across countries.

Time use studies capture trends in average durations (and interruptions) in reported daily sleep time but this is only just beginning to be systematically investigated [24, 25]. Recent research interest in the trade-off between components across the physical activity spectrum, with an examination of temporal trade-offs, for example, between screen-time and sleep among adolescents.

This Special Issue also contains a trend analysis of what time use data reveals about changes in eating habits. Previous time use research has started to investigate dietary and eating patterns across and between societies. Patterns of eating out, compared to domestic food preparation, showed marked differences between European countries and Anglophone countries [UK and US; 26]. This line of research can identify cultural and country-level differences that may advance our understanding of the obesity epidemic, with more home-prepared food and less snacking behaviour in Europe than North America [26, 27]. In addition, spatial geographic applications used with time use data identified "food deserts" in the US, areas where distance travelled to healthy food supply and food shops was substantially greater for socially disadvantaged people [28].

Mental health, happiness and subjective wellbeing have also been assessed using time use methods [29]. This can be combined with new technologies, and assess patterns the variation in mood across the day, and compares between countries and over time, in a standardised and comparable manner. At the clinical end of mental health research, there is important information to be gained through an exploration of how people with serious mental illness spend their time during the day [30].

The future of 24-h daily measurement is likely to be a blend of TUD usage, alongside technological developments in several types of objective measures. Although accelerometers cannot measure activity type or context, newer developments in wrist-worn wearable trackers often provide reliable measurement, have inbuilt GPS assessment, and often can differentiate activity types [31]. They also provide 24-h measures and can assess sleep time and quality [32]. Other approaches to assessing behaviours across the day use random time sampling, and assessing instantaneous estimates of current behaviour; this method, ecological momentary analysis (EMA) has been applied to physical activity and sedentary behaviour research, mood assessment, and eating behaviours [33–35]. Extensions of this idea relate to smartphone and device apps and web interfaces for assessing time use more broadly [36]. Continuous front-facing wearable cameras {"sensecams"} have been tested, and algorithms are starting to be developed to validate physical activity and dietary intake across the waking day, and compared to TUD [37].

Physical activity researchers have become interested in the 'spectrum of activity' across the day, including sleep time, and 24 h guidelines are proposed i902121.226Td[(The)-342setl

TUDs using traditional survey methods. The use of TUD in low-middle income countries is relatively rare, but could be particularly useful in monitoring rapid trends in urbanisation and industrialisation that lead to increased sitting time and reduced total physical activity; this is a potential benefit of TUD in more countries, especially those undergoing epidemiological and demographic transition. Globally, TUD remains as a valuable, and under-utilised, public health data resource, which can help to explain the present, and track trends over many decades, in a way that is unique among any population measurements.

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28. Hamrick KS, Hopkins D. The time cost of access to food - distance to the