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Recycling Behaviour Among Householders: Synthesizing Determinants Via a Meta-analysis

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Abstract A meta-analysis was made of results from previous studies on different variables influencing and determining the recycling behaviour of householders. These studies were conducted by researchers working in various fields in a number of different countries and are published in diverse journals. We evaluated trends in research outputs in the period 1990–2010, during which the provision of recycling facilities to householders has greatly expanded and requirements have become more extensive and often more complex. Variables affecting the recycling behaviour of householders were classified into four theoretical groups: socio-psychological, technical-organisational, individual socio-demographic and study-specific. These groups (clusters) were identified in a meta-analysis of 63 empirical studies culled from published research. The strongest predictors of householders' recycling behaviour were identified as being convenience, moral norms, information and environmental concern. The theoretical framework developed can be used to formulate questionnaires and in data analysis.

Keywords Recycling behaviour · Household waste · Motivation · Meta-analysis

Introduction

Recycling behaviour has been investigated within a number of disciplines and from different unique points of view. Each discipline looks at the specific variables within its

subject area, for example economists often look at monetary rewards such as volume-based pricing [1, 2] or weight-based pricing [3], whereas environmental psychologists often look at environmental concerns as the motivation for recycling [4]. Sociologists study social pressure, as the effect of external incentives [5]; legal researchers look at the effects of legal mechanisms such as mandatory recycling [6]; and engineers mostly investigate technologies and organisational schemes of recycling.

Many studies investigating the recycling behaviour of householders and the factors that determine their participation in recycling activities have been made since the early 1970s. According to Hornik et al. [7], the early literature on understanding and motivating household recycling comprises two phases. The initial phase (from about 1970 to about 1980) stresses economic incentives and a number of demographic characteristics, based on the idea that external monetary rewards can initiate and confirm recycling behaviour [8]. The next phase spans a period from about 1980 to about 1993 and concentrates on looking for ways to increase long-term commitment to recycling, based on ideas of social and psychological motivators for personal recycling behaviour.

Later studies have tried to identify different factors as correlations, motivations, determinants, barriers, reasons for recycling behaviour, etc. The variables studied vary greatly between different research areas and thus it is difficult to formulate general statements from the results. However, it can be clearly seen from the literature that recycling behaviour and other environmental behaviours are complex and diverse. Thus the predictors of recycling behaviour comprise a large set of diverse variables [9–11].

In the present work, we sought to demonstrate the variety of variables examined in studies of recycling behaviour in the approximate period 1990–2010. These

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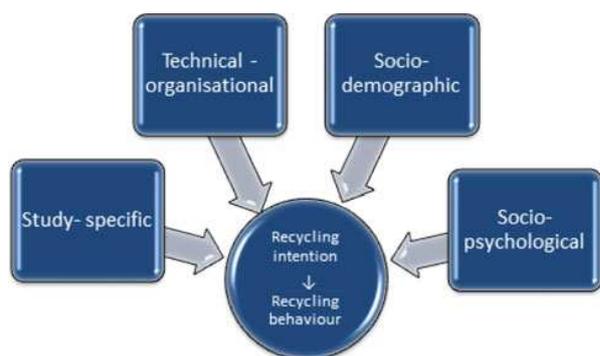


Fig. 1 Conceptualisation of variables examined in studies of recycling behaviour, 1990–2010

variables can be roughly divided into four theoretical groups: individual socio-demographic, technical-organisational, socio-psychological and study-specific, as shown in Fig. 1.

Of course some variables can be placed in different groups, for example past experience can be allocated to either the technical-organisational or socio-psychological group. Some researchers combine the socio-demographic and technical-organisational variables in one situational group [4]. The framework presented may be modified in the light of the discussion below and the empirical findings and analyses presented later in the paper.

The research aim of the present study was to provide an explanatory model for the recycling behaviour of householders using the conceptual framework presented in Fig. 1 as a guide to analysis. Specific objectives were to explore the diversity of variables examined in published empirical studies of recycling behaviour among householders in the specific 20-year period 1990–2010, identify the predictors from these various variables and highlight research issues for future studies.

Materials and methods

The material used comprised published literature sources in which household recycling behaviour was investigated. In all, 27 studies from the period 1991–2000 and 36 from the period 2001–2010 were investigated (Table 1). The studies were carried out in 17 different countries, but the majority were located in Europe. The largest number of studies originated in the UK and USA (18 and 12, respectively). The studies analysed used three data collection methods: self-reported surveys, actual measures of behaviour, and analytical reviews. The most popular data collection method was self-reported surveys, with postal questionnaires being the most frequently used method, followed by interviews, telephone interviews, street interviews, etc.

Table 1 Description of literature sources included in the meta-analysis

Study characteristics of sources	Number
Publication period	
1991–2000	27
2001–2010	36
Country of origin	
UK	18
USA	12
Sweden	9
Norway	5
Denmark	2
Hong Kong	2
Italy	2
Spain	2
Australia	1
Bangladesh	1
Ireland	1
Israel	1
Korea	1
Mexico	1
Portugal	1
Switzerland	1
Uganda	1
Data collection mode	
Self-reported survey	54
Actual measures	10
Analytical review	4

With self-reported methods it is not possible to verify the data, but the questionnaire survey is frequently used in consumer behaviour studies as it is one of the fastest and cheapest methods to cover a large sample size of respondents. In 10 studies, actual measures of behaviour were used, which included weight or composition analyses and direct observations of behaviour near recycling collection points. However, actual measures are rarely presented as the only data collection mode, being generally accompanied by self-reported surveys. In the present study we also included four analytical reviews of behavioural studies.

As regards defining recycling, in this study we adapted a definition of the theoretical, social marketing perspective, i.e. recycling as a product of recycling behaviour of householders, or as a product of their participation in local recycling schemes. According to Shrum et al. [12], the problems to be addressed from this perspective are how to get householders to adopt recycling in the home itself. The majority of the studies included in our analysis investigated recycling of packaging materials, such as plastic, glass, metal, paper and carton packaging, as well as newspaper. Some studies included recycling of organics and electronic waste.

To analyse the published literature studies, we used a meta-analysis technique. Meta-analysis is the process of combining study results in order to draw conclusions or to plan new studies [13]. From the mid-1980s researchers in many fields have been adopting systematic reviews and meta-analysis. Its best practice to date is in clinical research. For example, the Cochrane Collaboration has published the results of over 3,700 meta-analyses, which synthesise data on treatments in all areas of health care [14]. It is also commonly used in the fields of psychology, education and ecology. Meta-analysis follows several typical steps. In the first step, research objectives are formulated and clarified, while in the second step empirical studies are selected for the analysis. An attempt was made here to include published empirical studies that investigated predictors of recycling behaviour in the chosen period of time. Several methods were used to identify and locate relevant studies. Studies were initially located using a computerised key word literature search, then a manual search was made of four 'seed' journals known to publish articles about household recycling and recycling behaviour: Waste Management, Waste Management and Research, Environment and Behavior, and Journal of Environmental Systems. Finally, some articles were identified by the 'snowball' method from the reference lists of the studies already selected. A study was selected for the analysis if it included a factor that might influence recycling behaviour. The statistical significance of the data presented was not important, as our focus was on finding any dependence and correlation, whether positive or negative, between the study variable/s and recycling behaviour. Consequently, we applied our coding to every variable in the 63 studies included in the analysis.

Once the studies had been selected, we carried out qualitative and quantitative analyses of groups of variables determined in the studies. In parallel to these analyses, we developed a coding procedure for future statistical analyses. Used coding procedure can be sensitive to the statistical analysis [15]. A standard coding protocol based on the critical appraisal guidelines was developed for coding various articles [16, 17]. In order to make assessments of research quality, we adapted the appraisal checklist developed by Atkins and Sampson [17] by identifying 'best practices' in interpretative research and combining them with work already completed by McKay and Marshall [18]. Using established procedures for the checklist, each selected paper was evaluated by rating 29 criteria on a six-point Likert-type scale, from 1 (not met) to 6 (fully met). In addition to the appraisal checklist [17], the characteristics of variables and studies were coded. The most important items scored were: sample size, magnitude of effect, data collection, number of variables studied, empirical findings and direction of relationship.

Coding magnitude in the 63 studies chosen was straightforward and the reliability of the coding was increased by having three coders independently rate each study. Thus the data from each study were independently coded by two individuals. In cases of disagreement between these two, a third coder was asked to independently code the article and after this all three coders reached agreement.

When the coding procedure was completed, the meta-analysis was performed, mainly using the Hunter-Schmidt technique based on simple correlations calculated using SPSS analysis software to convert commonly used statistics. The Hunter-Schmidt technique is frequently used in such analysis as it allows the relative strengths of the simple correlations to be identified [19]. Specifically, the population correlation between a given variable and recycling behaviour was calculated as an average of each study correlation, weighted by the number of subjects in the study:

$$r = \frac{\sum (N_i \cdot r_i)}{\sum N_i} \quad (1)$$

where r_i is the observed correlation and N_i is the number of subjects in the i -th study.

Results and Discussion

Descriptive Analysis

Three groups of variables, socio-demographic, technical-organisational and socio-psychological, are mostly studied in combination in the published literature (Fig. 2). Unfortunately, the studies combine variables from all three groups infrequently (16 studies from 63). Some variables from the technical-organisational group in combination with some variables from the socio-psychological group are studied in 12 sources. Rather large numbers of studies

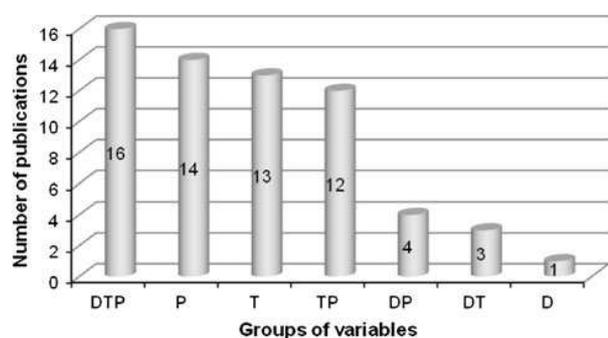


Fig. 2 Combinations of groups of variables examined and incidence in the 63 studies included in the meta-analysis. *D* socio-demographic, *T* technical-organisational, *P* socio-psychological

investigate the dependence of only technical-organisational or socio-psychological groups (Fig. 2).

Socio-Demographic Variables

Socio-demographic variables, or as some researchers named this group socio-economic variables, are the most commonly investigated predictors and have been presented in a large number of publications on recycling [7]. However, as can be seen from Fig. 3, in our analysis only 24 of the 63 studies included mentioned one or more socio-demographic variables. This can be explained by the fact that almost all studies report the socio-demographic characteristics of the sampled population, but only some of them investigate the dependence or correlation between recycling behaviour and socio-demographic factors. The most commonly and widely used socio-demographic variables investigated in the literature are age, gender, income, education level and dwelling, so they were included in our analysis.

The three most studied variables from these five are age, income and education level (Fig. 4). As regards the actual research findings, these are very ambiguous (Fig. 5) and

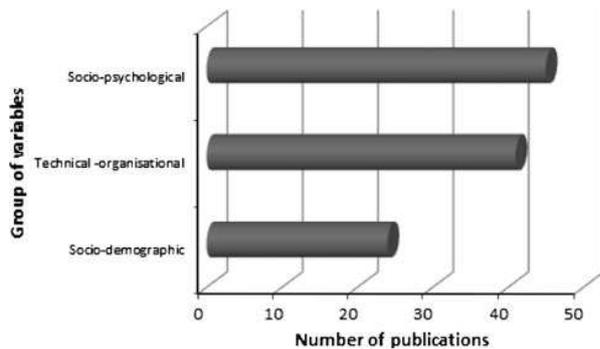


Fig. 3 Groups of variables examined and incidence in the 63 studies included in the meta-analysis

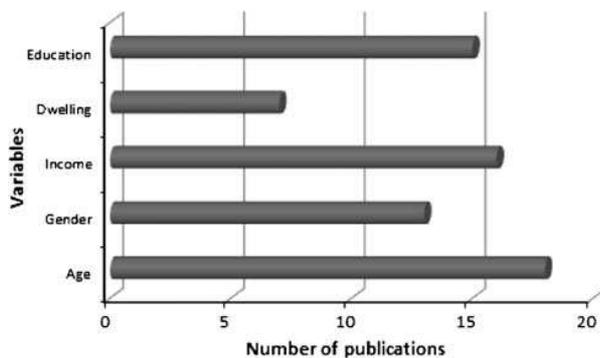


Fig. 4 Socio-demographic group of variables and incidence in the 63 studies included in the meta-analysis

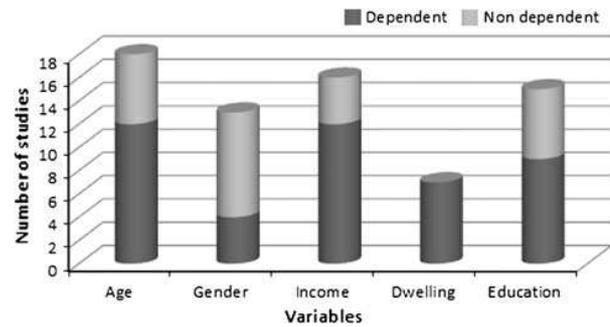


Fig. 5 Dependence between recycling behaviour and socio-demographic group of variables in the 63 studies included in the meta-analysis

age is the most frequently investigated (Fig. 4). Some authors have found a relationship between recycling behaviour and age [10, 20–29], but others report no significant correlation [4, 7, 30–33].

According to Saphores et al. [25], middle-aged adults (36–65 years old), although they typically have full-time jobs and families, seem to be most willing to recycle. In the line with this, Meneses [24], reported that people whose age is far from the average of the working population (around 31–50) have more barriers to participating in recycling. However, as the norm of recycling has become generalised throughout society, in the study by Oom do Valle et al. [31] the age variable had lost its power and showed no correlation with recycling behaviour.

Another frequently investigated variable is *income*. Most researchers have found correlations between income and recycling behaviour, as we can see in Fig. 5 [9, 20–23, 28, 32–37], whilst a minority of others have reported no correlation [7, 25, 26, 31]. However this correlation is not constant. The analysis by Kurz et al. [37] indicated that participation in recycling is highest in high income areas, with medium income areas being intermediate. These findings support other studies reporting a higher level of participation in recycling among those with middle- to upper level income [34, 35]. In contrast, a study of income elasticity by Hage and Söderholm [33] suggested that households with higher income are not necessarily more willing to recycle more than low income households. They argue that the opportunity cost for the households must also be considered. Recycling is a time-consuming activity, so the opportunity cost of recycling would increase with income.

In 15 of the 24 literature sources that study socio-demographic variables, *education level* is included. As can be seen from Fig. 5, the results regarding influence of education level on recycling are not consistent. Correlations have been reported with years of schooling and future higher education [9, 21, 22, 25, 26, 29, 30, 33, 35], but a

similar number of researchers have found no significant dependence [7, 24, 31, 32, 38, 39].

Looking at the empirical findings on the group of sources which reported that education level has an influence on recycling behaviour, they conclude that a high education level increases the possibility of source separation and recycling and lowers the frequency of difficulties encountered with such activities [29]. This is in line with Saphores et al. [25], who found that lack of college education decreased willingness to recycle. On the other hand, Schultz et al. [30] report that members of households with a higher level of education bear a lower burden of the recycling role than members of households with a lower level of education.

The variable *gender* is linked with very interesting results. While some authors [25, 38] have found evidence that women engage more readily in pro-environment behaviour and are more involved in waste-related activities, the majority of studies show gender to be an unimportant variable (Fig. 5). Those reporting any dependence between gender and recycling behaviour include Barr et al. [22], Meneses and Palasio [24], Saphores et al. [25], Ekere et al. [38], and the majority have found no significant correlation [7, 26–33].

The less frequently presented socio-demographic variable (Fig. 4), but the most homogeneous according to the results, is *dwelling type*. The studies which have included this variable unambiguously show a significant correlation between recycling behaviour and dwelling type, as represented in Fig. 5 [4, 9, 21, 22, 26, 33, 36]. Most of the findings on this issue make it possible to state that private housing (single-family dwelling) positively influences recycling behaviour. This means that householders living in single-family private house recycle more than those who live in multiple-family apartment dwellings. This is explained by more space availability for storing recyclable materials in a single-family dwelling and higher general environmental concern among such homeowners [26]. However, the reason for environmental concern has been found to be unclear by several authors and is discussed later below.

Of the five socio-demographic variables, two can be concluded to be significantly dependent: age and income. The variable of dwelling has not been examined in a significant number of studies, but shows absolutely consistent results as being a correlated variable in the studies in which it has been presented. We can therefore assume that it is a nominally dependent variable. Gender has consistently been shown to be not important as a variable for recycling behaviour, while education has been found to be the most ambiguous and cannot be defined as either as dependent or nondependent for recycling behaviour (Fig. 5).

These five variables are the most commonly investigated within the socio-demographic group. In the studies it is also

possible to find variables such as family size, presence of emigrants and population density. These variables can also be included in our socio-demographic group, but as the numbers of studies where these variables are investigated are small, they are included in one special group, the group of study-specific variables discussed later in this paper.

Technical-Organisational Group of Variables

The recycling behaviour of householders relates to the question of the collection scheme available for them or, as often mentioned in the literature, technical and/or organisational systems, or simply technology. Some authors also call this group physical and material structure [40]. These systems include the containers, collection vehicles, methods, distance to collection points, design of the whole scheme etc. Household waste collection schemes vary throughout the world, from no organised collection at all to the collection of 10 separate recyclable fractions at the doorstep using multi-compartment vehicles [41]. These schemes are dependent on natural conditions such as climate and soil and on man-made physical constructions such as housing, population density, etc. In the literature, this group of variables always reflects the idea that a collection scheme represents a conflict between two opposing interests, the collector (collection organisation) and the household. There is always a conflict of physical accessibility for the collector on one hand and householders on the other. For the collector, more central collection points seem more attractive and economically efficient. For householders, a closer collection point means less effort and is more convenient, while centralised collection points may result in inconvenience for many householders [41].

We found that the technical-organisational group of variables has been investigated in 43 of the 63 studies analysed (Fig. 3). According to some authors [42], a major technical-organisational factor is contextual and spatial differentiation in recycling services and provision (for example, access to a kerbside recycling bin in the single dwelling or property close collection in multi-dwelling areas). However in our studied sources this factor is generally not presented. Our group of technical-organisational variables encompassed three sets of variables: convenience, unit pricing and access to kerbside (property close) collection. According to our analysis, the variable of convenience is presented in the majority of the studies examining technical-organisational factors (29 of 43 sources), unit-pricing appears in 20 studies and kerbside access in 8 of 43 studies (Fig. 6).

In all, 28 independent surveys have identified the 'inconvenience factor' as an important reason influencing recycling behaviour (Fig. 7). This variable has been approached primarily within empirical studies in marketing

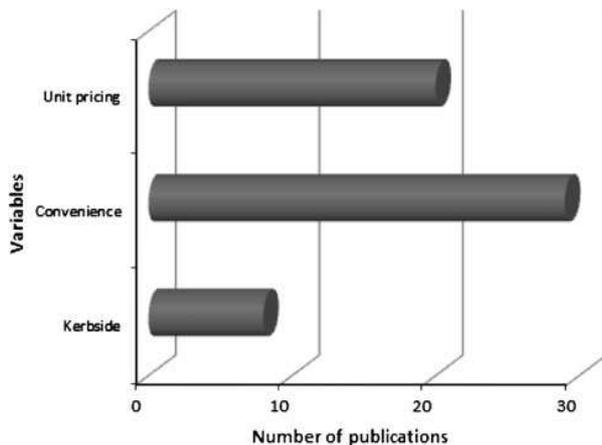


Fig. 6 Technical-organisational group of variables and incidence in the 63 studies included in the meta-analysis

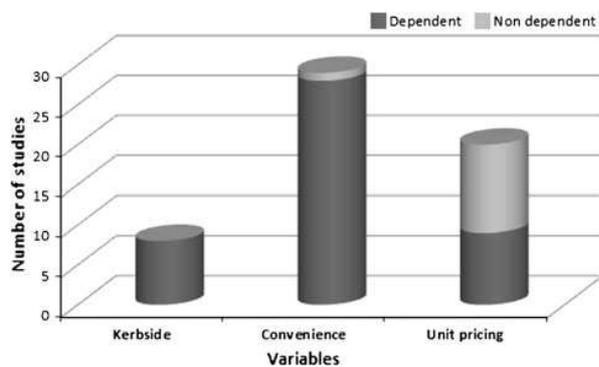


Fig. 7 Dependence between recycling behaviour and the technical-organisational group of variables in the 63 studies included in the meta-analysis

and social psychology. Correlations between *convenience* and recycling behaviour have been reported [4, 7, 9, 10, 22, 23, 25, 28–31, 34, 43–56] and only one study reported no significant dependence [33].

In the present study, ‘convenience’ refers to the transparency of the collection scheme: how easy is to understand and ‘manage’ (use). We found many important aspects to be included in the variable of ‘convenience’, for example, frequency of collection, technical mismatches, distance and location of collection points, cleanness of recycling sites, transportation, handling problems, easy access, storage space, ease of use, design of collection points, etc. According to Refsgaard and Magnussen [55], people frequently mention in discussions that *easy and friendly recycling systems* are important to using them in an appropriate way. Some authors go beyond this, concluding that the main influence on recycling behaviour is recycling logistics [4].

The factor *design* also has significant importance [52]. The visual design (smart design) of collection points can

positively influence the convenience of recycling behaviour and is dependent on the economically affordable pricing for the area. Recycling stations with over-full containers and litter can also result in lower participation [52]. Suitable location of recycling stations near households or on the way to other facilities may influence recycling behaviour. A correlation has been found between *location facility* and cost of participation [57], leading those authors to conclude that locating the facility in a suitable place is one way to reduce the personal cost and stimulate recycling behaviour. According to Gonzalez-Torre and Adenso-Diaz [51], as the *distance* to the recycling bins decreases, the number of fractions that citizens separate and collect at home increases. The findings about *number of fractions* collected are somewhat mixed. According to Everett and Pierce [58], multi-material collection tends to encourage participation in recycling, although much participation does not recycle all allowable fractions of materials. On the other hand Jenkins et al. [49] comment that the personal cost of bringing multiple materials to containers may be too high for many people and those schemes with fewer categories of recyclable material frequently report a higher participation level.

Finally, McDonald and Oates [50] point out that having insufficient *storage space* is a factor that can determine recycling behaviour, a statement confirmed by Oom de Valle et al. [31]. In contrast, a study by Coral-Verdugo [59] in Mexico on recycling and reuse reported the reverse, people with increased space in their houses more frequently increasing consumption and waste generation rather than improving recycling.

Very interesting results have been reported by De Young [60], who that non recyclers and recyclers have fundamentally the same attitudes toward recycling and that the perception of inconvenience is the main factor that distinguishes both of these. He concluded that the central issue that needs to be addressed is ‘how to recycle’ rather than ‘why to recycle’.

The next variable analysed in the technical-organisational group was *access to kerbside recycling scheme* for the single-family dwelling or *property close collection* for the multi-family dwelling. This variable is presented in only 8 of the 43 sources included the technical-organisational group (Fig. 5), and the results are absolutely consistent. All sources analysed (Fig. 6) report that access to kerbside recycling stimulates recycling behaviour and increases recycling of all material types [4, 9, 22, 26, 49, 54, 61, 62]. According to the authors, this indicates that recycling based on any system other than kerbside (property closed) collection (mostly drop-off stations involving storage, time and transport costs for individuals) can lower participation. However many authors who found a dependence between recycling behaviour and access to kerbside

collection also note opposing interests between the collectors, for whom central collection points seem more attractive and more economically efficient, and householders, who want access to collection close to the home. This factor often influences the choice of scheme.

In many countries worldwide, waste collection is funded by different forms of local tax and people are not aware of the actual cost. However, the introduction of *unit pricing* (also variously referred to as bag-and-tag or pay-as-you-throw pricing) for recycling collection is becoming popular. The charge for waste collection can be based on volume or weight. Volume-based billing often offers householders the possibility of choosing collection frequency and/or size of waste bins. In weight-based billing, householders pay a certain amount per kilogram of unsorted waste.

Many researchers have investigated the relationship between unit pricing and recycling behaviour. According to our analysis, 9 of the 20 studies (Fig. 7) that include this variable report some dependence between unit pricing and household behaviour [3, 7, 8, 11, 20, 30, 33, 45, 63], while 11 of 20 report no link between them [2, 26, 49, 55, 56, 61, 64–68]. Thus the results are not consistent. According to Hage and Soderholm [33], weight-based schemes can be effective if the problem of illegal dumping can be avoided. However Hage et al. [26] concluded that weight-based schemes may be effective only in reducing waste rather than improving recycling behaviour. According to a study by Dahlen and Lagerkvist [68] in Sweden, the effect of weight-based billing is inconsistent. They report a clear reduction in waste in some municipalities, but a barely noticeable change in others where a weight-billing system was introduced. None of these differences could be explained by higher recycling rates and no differences were found in the amount of separated recyclables per capita compared with that in other municipalities without weight-billing. They concluded that people with weight-billing can adapt a lifestyle producing less waste or that they may dispose of their waste outside the ordinary collection system.

A very detailed and thorough study by Fulerton and Kinnaman [1] on the consequences of volume-based pricing showed that householders sometimes reduced the volume by means of number of bags or by smaller size of containers, but not the weight, namely through compressing. Others warn of the risk of volume pricing causing an increase in illegal dumping, fly tipping and illegal burning [69]. Many economists view recycling as any other activity, and pass it through standard cost-benefit tests in which personal motives are unchallengeable and irrelevant [8]. However, according to Pickin [2], householders are not behaving as most economic models assume: they are reducing waste and participating in recycling for non-economic reasons. Interesting findings in this regard by Refsgaard and Magnussen [55] are that cost is a criterion

that seems to give no strong link between attitude and behaviour activity. People report being motivated by money, yet they do not always act in accordance with this claim. Many of the respondents in different studies did not know the price they actually paid for waste services [70].

Only one of the technical-organisational variables can be concluded to be significantly dependent: convenience. However, while the variable of access to kerbside collection was not examined in a significant number of studies, there were absolutely consistent results that it positively influences recycling behaviour. Therefore it can be assumed to be a nominally dependent variable. The variable of unit pricing was found to be the most ambiguous and cannot be defined as dependent or non dependent (Fig. 7).

Socio-Psychological Group of Variables

In the papers included in our meta-analysis the group of socio-psychological variables is the most frequently studied (Fig. 3), with 46 of 63 studies having investigated one or more variables from this group. We included 7 variables in this group (Fig. 8). Four of these are motivational factors (general environmental concerns, moral norms, legal norms, social norms) and three can be summarised as ‘situational’ (information and knowledge, past behaviour, personal effort). The ‘situational’ variables are sometimes included in the technical-organisational group [4]. However, we opted to include them in the socio-psychological group as they are very dependent on, and influenced by, the perception and personal traits of individuals rather than the technical design of the recycling scheme.

As can be seen from Fig. 8, the variable of *moral norms* (personal concerns about recycling) is a leader (30/46 studies). We should note here that investigating a level of personal concern, as for all motivational factors, is a challenging activity and can be done only as a self-reported measure. Most recent empirical studies of moral personal

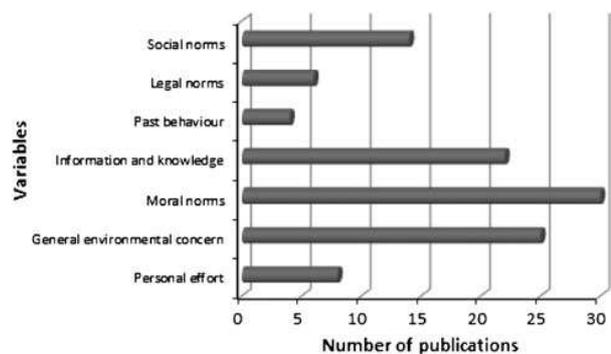


Fig. 8 Socio-psychological group of variables and incidence in the 63 studies included in the meta-analysis

norms apply the method of psychological scale, designed to relate some of the individual's intrinsic motivation to recycling. This motivation includes: personal satisfaction in recycling and being more self-sufficient, general satisfaction from participation, and awareness of the importance of recycling [59]. In investigating this variable, researchers generally use surveys presenting a series of statement regarding recycling behaviour with which interviewees express their degree of agreement or disagreement. Personal belief studies are often based upon the individual's perception of an activity being right/wrong, good/bad, useful, desirable, pleasant, interesting, etc.

From our analysis we can conclude that there is a general trend in the importance of moral personal norms for recycling behaviour; personal moral norms are a highly internalised attitude which will govern individual recycling behaviour. Some authors report a correlation between moral norms and recycling behaviour [4, 7, 9, 22, 24, 26, 30–32, 37, 39, 44, 47, 48, 53, 59, 67, 71–78]. Only five studies included in our meta-analysis found no significant relationship between moral norms and behaviour [8, 27, 28, 36, 62].

The findings in studies claiming that moral norms are important to explain recycling behaviour are rather consistent (Fig. 9). Generally, they conclude that individuals will recycle if they feel personal responsibility to do so. According to Berglund [32], moral motives significantly lower the cost associated with household recycling efforts and, as a result, increase recycling participation. Meneses and Palacio [24] found that persons with negative motivation towards recycling had greater barriers to recycling than those who were less negatively motivated. A study by Kurz et al. [37] pointed out a high influence of specific attitude toward recycling on recycling behaviour. Some results show that moral norms are important for those

attending drop-off sites and less important for kerbside collection owners [62].

However, one school of thought considers that recycling is fundamentally an altruistic behaviour (Schwartz altruistic model) [79]. Following this model, Martin et al. [36] found altruism to be the common motive for recycling. These findings are contested by many other authors, who suggest that the important 'antecedent' of altruism when applied to recycling behaviour is the development of a personal norm that 'recycling is the right thing to do' and that only after the development of strong moral norms can altruism lead to people performing recycling activities.

Another rather frequently investigated variable in the socio-psychological group is *general environmental concern*, or pro-environmental attitude as some authors name it [31]. This attitude is normally measured on a Likert response scale in questionnaire surveys. As Vining and Ebreo [80] point out, this scale measures a constellation of attitudes that represent the respondent's adherence to a world view of the relationship between humanity and the environment. Although one might expect that a high level of environmental concern would have a direct and positive link with recycling behaviour, the findings are not homogeneous. The majority of studies included in our analysis that examine this variable conclude that environmental concern has a correlation with recycling behaviour [7, 20–22, 24, 28, 29, 31, 33, 38, 44, 48, 52, 55, 67, 71, 75, 76]. However, some studies report no significant relationship or a very weak relationship between this variable and recycling behaviour [4, 10, 36, 37, 39, 53, 62]. The former group of researchers argue that those individuals with more positive general environmental values and attitudes are more likely to express a higher level of recycling behaviour. For example Bruvoll et al. [75] in his study in Norway found environmental concern to be a significant predictor of actual recycling behaviour. Conversely, authors such as Kaiser et al. [81] support the argument that the strong link found between environmental concern and recycling behaviour often reflects failure to measure attitude at a suitably high level of specificity, and that in reality moral norms rather than environmental concern predict recycling behaviour. More recent studies have noted that given the great amount of media devoted to environmental problems, it may be the case that many people have learned the language of environmentalism without developing a simultaneous behavioural action [28].

The variable *information and practical knowledge* is of great interest in studies examining the effects of campaigns and education strategies on recycling. Of the 46 studies that examine the socio-psychological group of variables, 22 include this [3, 4, 7, 9, 10, 22, 29, 31, 44, 47, 48, 52–56, 59, 77, 78, 82–84]. The findings of different studies vary and they investigate different aspects of this variable. However,

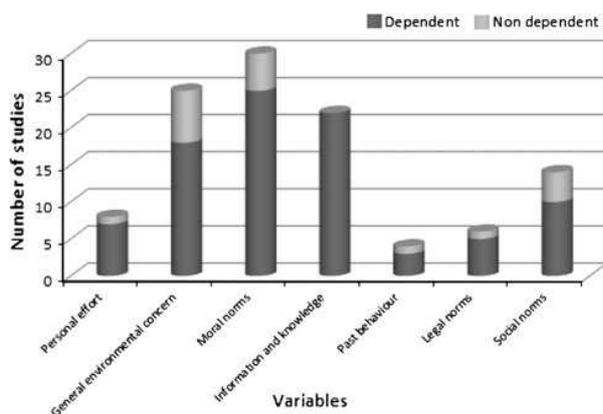


Fig. 9 Dependence between recycling behaviour and socio-psychological group of variables in the 63 studies included in the meta-analysis

all of them agree that information campaigns and education strategies on recycling have a positive and significant correlation with recycling behaviour (Fig. 9). For example, Corral-Verdugo [59] made direct observations on randomly selected families of Mexico and found a direct link between specific recycling knowledge and behaviour. Ebreo and Vining [85] cite findings which support the idea that educational programmes have an effect on the relationship between people's attitude and their recycling motives. Information may help to increase and sustain residents' intention of separating different wastes and recycling [84, 86]. According to Refsgaard and Magnussen [55], specific and individual information is very important. Participants in their study in Norway often reported having received information, but claimed that they did not understand all this information and that it was often vague, too general and not very useful. General leaflets with often inappropriate information or vague statements are not viewed as useful, which can be perceived as a need for more specific individual information [78]. In our analysis of previous publications, we were able to identify two types of information and knowledge that affect recycling action: 'abstract' and 'concrete'. 'Abstract' is a measure of general recycling knowledge and information, while 'concrete' concerns recycling provision, awareness of how and what to recycle. Numerous studies have pointed out the greater importance of 'concrete' information and knowledge [87].

Social norms are another variable from the motivational factor which can influence recycling behaviour. The social norms are often defined as norms maintained by significant others who are important for the person. Survey respondents are normally asked whether they believe that their spouse, their children or their neighbours have any expectations about the respondent's recycling behaviour. Our analysis showed that the variable of social norms is examined in 14 publications (Fig. 8). Ten of these point out some dependence between social norms and recycling behaviour [4, 7, 11, 20, 27, 32, 62, 72, 75, 76]. Åberg [44] notes that family is a dynamic unit and that individual members of such a unit do not have access to identical information and do not necessarily develop identical values. In spite of this, they can influence each other attitude about recycling behaviour. Similarly, Bratt [62] concludes that social norms reveal a direct influence on recycling behaviour, with partners influencing each other and children having a significant influence on the family's behaviour. The relevance of social pressure exercised by children may be of particular interest in recycling behaviour [32], due to the fact that children often receive environmental education at school. At the same time, Åberg [44], who studied participation in source separation of organic waste for composting facilities, concludes that parents want to participate in order to show their children what one can do

to contribute to protecting the environment. However, several studies have found that social norms will operate if the recycling behaviour is visible to others, for example in the case of kerbside recycling.

In contrast, Chan [73], Knussen et al. [78], Tonglet et al. [53], and Hage et al. [26] report that social pressure has no significant correlation to recycling. These studies suggest that social norms may operate at an early stage of a recycling scheme, but when this recycling scheme is well-established people have already had time to develop strong attitudes (positive or negative) and they are not influenced by external social pressure. For example, Hage et al. [26] report that in Sweden, where source separation collection has long been in use, household recyclers tend not to be influenced by friends, family and other important persons.

Participation in waste source separation is a behaviour which demands that householders spend a significant amount of personal resources and some extent of effort. Items for recycling must be retained and perhaps washed, then stored, and, later, taken to the recycling point in the case of packaging materials. Electronic waste requires effort in storage and later taking to a drop of collection point, which is normally situated only within driving distance. Different types of waste materials require different amounts of effort as regards time, space, transportation and other. Several studies have linked recycling behaviour to the variable of *effort* as an external facilitator. In our analysis, 8 studies included the variable of personal effort and seven of these reported some dependence between effort and recycling behaviour [4, 38, 48, 53, 75, 76, 88]. The authors pointed out that householders may not recycle due to the sheer effort required to overcome high personal barriers. Similarly, Vining and Ebero [80] and Oskamp et al. [89] reported time to be a major effort and important inconvenience factor in performing recycling behaviour, while economists also underline the high opportunity cost of time in their studies [38]. Conversely, only Hornik et al. [7] do not report any significant dependence between personal effort and recycling behaviour. They suggest that personal motivation and organisational convenience dramatically reduce the importance of personal effort.

The variable of *legal norms* is rarely investigated. It is included in only six of the 63 studies included in our analysis (Fig. 8), five of which report some correlation between legal norms and recycling behaviour [4, 29, 32, 75, 76], while Hage et al. [26] found no correlation (Fig. 8). However, the findings are rather inconsistent.

Finally, some researchers have studied the variable of *past behaviour* but the number of studies investigating this socio-psychological variable to date is rather small (it was only found in 4 studies included here, Fig. 8). However, the role of past behaviour in the prediction of intentions is continuing to attract researchers. Barr et al. [22] found past

behaviour to be very important toward current intentions, while according to Tonglet et al. [53] previous experience lowers the perception of effort. In an early study by Knussen et al. [78], past behaviour was a significant predictor of both intention to recycle and actual behaviour, but this correlation was not found in their later work [27].

According to this descriptive qualitative analysis of socio-psychological variables from literature sources, we can conclude that the variables moral norms, information and general environmental concern have some dependence with recycling behaviour. The variables social norms and personal effort are not included in a significant number of studies, but show a positive trend and can be assumed to be nominally dependent variables. It is not possible to state whether the variables past behaviour and legal norms are dependent or non dependent due to the few results reported (Fig. 9).

Group of Study-Specific Variables

This group includes very diverse variables, all of which are relatively rarely studied and mostly specific for the concrete study. We did not include them in any quantitative analysis, but a brief descriptive analysis appears appropriate to show the complexity and diversity of factors influencing recycling behaviour.

The literature contains some references to a variable called *population density*. A study by Ekere et al. [38] shows that urban respondents are less likely to sort compared with their peri-urban counterparts, Hage et al. [26] has found that as population density increases recycling decreases, resulting in low collection rates in major cities. Some studies such as that by Saphores et al. [25] examine the relationship between *political allegiance* and recycling. Those authors found that Democrats exhibited a stronger willingness to recycle in the USA.

Studies focusing on *religious identity and ethnicity* have been carried out by several authors. Kurz et al. [37] carried out research in Northern Ireland and found that mean participation rates were significantly higher in areas of mixed religious identity. In addition, he found that participation rates in Catholic areas were significantly higher than in Protestant areas. Goggins [9] points out from his research that ethnic minorities tend to recycle less, but notes that this tendency could be due to low affluence rather than any racial characteristic.

A very interesting and increasingly attracting variable studied by Kurz et al. [37] is *sense of community*. The concept of sense of community originates from community psychology studies. It was originally formulated by Sarason [90] and later refined by MacMillan and Chavis [91] to include membership (the sense of feeling part of the group), influence (the sense that individuals matter to the

group and the group can influence its members), integration (the sense that members' needs are met by the resources received through their membership in the group) and shared emotional connection (the sense of shared history in the community). In other words, sense of community is a level of social interaction within a community or neighbourhood, which can be defined in less strictly geographical terms than community [92]. Investigating this variable, Kurtz et al. [37] found a positive correlation between individual level of sense of community and recycling participation. In addition, he pointed out that sense of community accounted as much for recycling participation as personal moral norms.

With the increase in migration processes, the variable of *new immigrants* has become the focus of research. In a Swedish study by Hage et al. [26], this variable is correlated at the statistically significant level. Their explanation is based on the idea that when immigrants arrive in the new place they are not very well acquainted with laws and regulations and cannot understand the language very well. This situation can result in low participation rates. However, as time goes by immigrants pick up existing social norms of behaviour and they sort even more than the average Swedish citizen. However, Martin et al. [36] comments that second generation immigrants has much lower willingness to recycle than their parents.

A recent study by Ekere et al. [38] suggests that recycling behaviour is influenced by the *amount of waste which the household generates*: the more waste generated, the less likely it is to sort it. This is in the line with consumption behaviour and such variables as *shopping behaviour*, which according to Domina and Koch [34] is a significant predictor of recycling behaviour. However the relationship between these factors appears to be very complex.

Statistical Analysis

In our analysis, we only used the groups of socio-demographic, technical-organisational and psychological variables. The group of study-specific variables was excluded, as the number of results was statistically insignificant. The 15 variables examined in the three groups composed the group of independent variables. This dependent variable was treated as one-dimensional entity and called 'tendency to recycle'. It was composed of the average correlation for three dependent variables presented in the studied literature—attitudes toward recycling, actual recycling behaviour and behaviour intention. The majority of the studies use attitudes toward recycling or behavioural intention because most of these studies are based on self-reporting behaviour (Table 1). Several studies contain measures of actual behaviour and the dependent variable in this case was actual recycling behaviour.

Table 2 Mean correlation of predictors of household tendency to recycle in the studies included in the meta-analysis

Predictor	Mean r	Number of coded r
Socio-demographic		
Age	0.1304	18
Gender	-0.1086	13
Income	0.1739	16
Dwelling	0.1521	7
Education level	0.0652	15
Technical-organisational		
Kerbside collection	0.1739	8
Convenience	0.5869	29
Unit pricing	-0.0434	20
Socio-psychological		
Personal effort	0.1304	8
Environmental concern	0.2391	15
Moral norms	0.4347	30
Information	0.4782	22
Past behaviour	0.0434	4
Legal norms	0.0869	6
Social norms	0.1304	14

It should be noted that this difference in the mode of data collection can also influence the results. According to Hornik et al. [7], it might be examined as a moderator variable. However, we do not present these studies because our intention was to identify any correlation between independent variables and dependent variables of tendency to recycle.

Table 2 shows for each predictor in the first column the information of mean correlation calculated with three or more dependent measures. Predictors with only one or two correlation results were excluded.

As can be seen from the results, the strongest predictor of recycling tendency is in the technical-organisational group, namely convenience of the facility. This result is in line with our results from descriptive analysis, where we concluded that convenience is a variable which has significant dependence with recycling behaviour.

The variables moral norms and information in the socio-psychological group have a rather similar level of correlation with tendency to recycle and are the second most important set of predictors reported. Similar results were obtained from the descriptive analysis. The third predictor, environmental concern, is also from the socio-psychological group of variables. Although this variable has a less significant mean of correlation than convenience, moral norms and information, it could predict the tendency to recycle.

Groups of variables defined as nominally dependent in the descriptive analysis (dwelling, kerbside collection,

personal effort and social norms) are not significant predictors of tendency to recycle. The strongest prediction from this group is 0.1739 (Table 2), which relates to kerbside collection facility and can be interesting as a facilitator in recycling behaviour. This variable is followed by personal effort and social norms (0.1304) as variables which have some level of influence on the recycling behaviour of householders.

Interesting results are found in the group of socio-demographic variables. Although many recycling studies frequently examine demographic factors and in our descriptive analysis we assumed age and income to be dependent variables, this analysis shows the socio-demographic group to be a poor collection of predictors (Table 2). The strongest predictor is 0.1739, which relates to household income. It seems that demographic factors are important in describing the background of the sampling population but cannot be included among predictors of recycling behaviour.

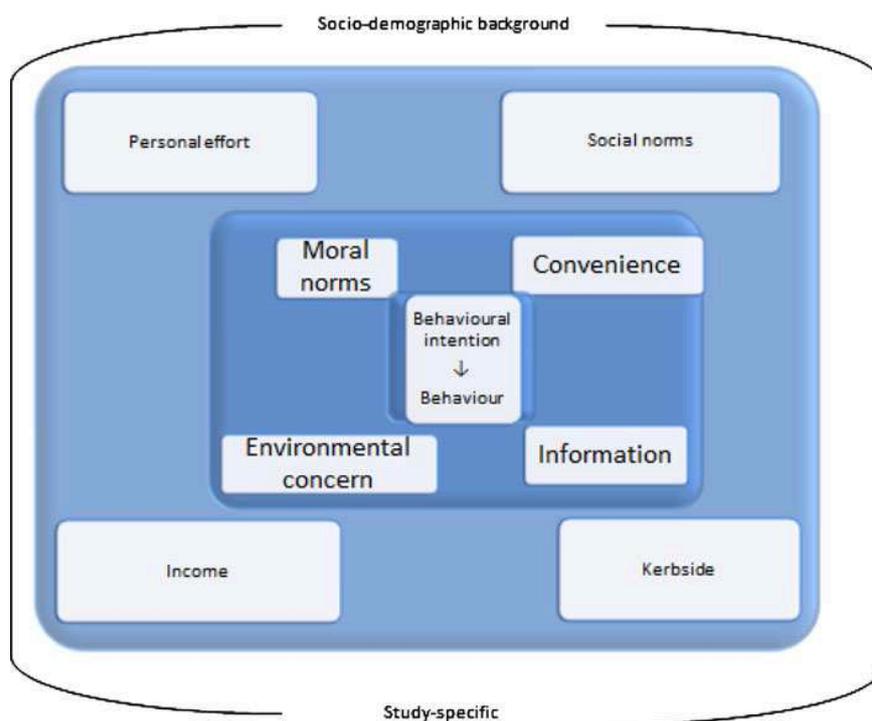
Finally, variables of pricing and past behaviour give the poorest prediction of tendency to recycle. This is in line with the descriptive analyses, where the variable of past behaviour was difficult to define and was assumed to be not identified, while the variable of pricing was identified as not dependent.

An Explanatory Model of Householders' Recycling Behaviour

We propose the empirically composed explanatory model depicted in Fig. 10 to reflect the major findings of the meta-analysis. The elements are arrayed in decreasing order of importance from the centre to the edges of the figure. The four strongest predictors obtained by the meta-analysis: convenience, moral norms, information and environmental concern, are represented in the centre of the model, close to behaviour intention. Variables such as kerbside, personal effort, social norms and income are relatively less strong in predicting the behavioural intention and are located in the corners of the model.

In the nuclear centre of our model we locate behavioural intention, which is determined by different factors. Research guided by the Theory of Reasoned Action [93] and later by the Theory of Planned Behaviour [94] has repeatedly shown that intention, measured close to the time when the behaviour is performed, is the strongest predictor of behaviour, with intention being determined by other factors. As can be seen from Fig. 10, the strongest determinants of recycling behaviour intention according to our model are from the socio-psychological and technical-organisational groups of variables. The predictors have their independent influence on recycling intention and may

Fig. 10 Explanatory model of recycling behaviour determinants



influence recycling intention to differing extents depending on the types of waste included in the recycling programme. For example, effort can have a greater influence on electronic waste recycling intention. However the proposed model underlines the following framework: In order to perform recycling behaviour, the householder is assumed to have a tacit moral reason supported by environmental concern about the recycling activity; to be aware and have knowledge about recycling programme; and to have no major convenience barriers. Factors such as a social environment that is conducive to recycling, presence of kerbside collection facilities, and reduced extent of perceived personal effort facilitate the recycling behaviour intention.

The socio-demographic group excludes income, identified as a poor predictor but included in our model as necessary background on the study population. The group of study-specific variables is present on the edge of the model, as such variables often have a major influence on the behaviour of a particular group in terms of short-term recycling.

Every predictor from the four groups of variables studied has interrelationships but neither previous studies nor the present model can identify any of these interactive effects. Details of the specific recycling situation must always be presented. However, the complexity of the interactions among the various predictors should be recognised, because no variable acts alone. For example, environmental concern about recycling as an important activity alone cannot guarantee that recycling behaviour

will be adopted by households. Factors such as the inconvenience barrier, lack of information and lack of positive personal values that reduce the extent of the personal effort can be overwhelming and recycling behaviour may not be performed.

Concluding Remarks

The aim of this study was to summarise studies on householder recycling behaviour studies published in the period 1990–2010 in order to present the current status of research in the area, offer a conceptual scheme and identify research issues needing future investigation. The meta-analysis provided interesting findings for researchers investigating and promoting recycling behaviour, the most striking result of which is the strong relationship between convenience, or moral norms, and recycling behaviour of householders. The convenience factor is highly important in devising new technological changes in source separation and collection schemes for household waste, which must be affordable and widely accepted by the public. In our technologically advanced society, source separation schemes design is mostly simple and old-fashioned, which does not reflect people's attitude. There is a need to develop 'smart', attractive and convenient schemes based on the needs of present householders in order to involve them in recycling. Source separation schemes are usually created to be efficient for experts in waste collection and

the efficiency of these schemes from the user perspective is often ignored. In addition, the strong correlation between moral norms and recycling behaviour suggests a need for a strategy based on creating a social image of recycling as a useful, pleasant and important activity.

Two other variables were also important predictors of household tendency to recycle: information and environmental concern. From these findings we can conclude that the implementation of recycling schemes should be accompanied by sufficient publicity and promotion in order to educate the participants, and that there is a need to reinforce the recycling message regularly. However, cost will almost certainly dictate the methods and schemes used.

The variables personal effort, access to kerbside collection, social norms and income have less correlation with recycling behaviour, but are still important for predicting the recycling behaviour of householders. Apart from income, socio-demographic variables appear to be poor predictors of recycling behaviour, but this group is important for describing the background of the study population.

From our analyses of published literature we can also conclude that there is a lack of studies where the socio-psychological and technical-organisational types of variables are combined. Variables from these groups are frequently studied separately and it is difficult to identify the interrelationships between them and complete the picture of recycling behaviour. There is a need for future investigations combining these groups of variables.

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