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I do as I am: understanding and leveraging identity to promote smoking cessation and physical activity

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Chapter 3

Conceptualization, operationalization and role of identity in physical activity and smoking in individuals aged forty-five and over: A systematic scoping review

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ABSTRACT

Purpose: Identity is a determinant of health-promoting behaviors such as physical activity and health-compromising behaviors such as smoking. This scoping review provides a comprehensive synthesis and comparison of the relationship between physical activity- and smoking-related identity and behavior, and how these identities are defined and measured. Study participants' personal, physical activity-related and smoking-related characteristics were considered where applicable. The review focuses on people aged 45 and above.

Methods: A thorough search across 11 databases yielded 5801 unique publications. Ensuing careful screening, 45 peer-reviewed empirical studies were systematically reviewed. Experts in the field contributed to validate and structure the narrative.

Results: Findings revealed the existence of an intricate, enduring direct and indirect relationship between identity and behavior for physical activity and smoking. Numerous similarities and differences in this relationship, as well as in identity-related terminology and measurement tools used were identified. In essence, endorsing an identity related to physical activity and smoking abstinence is important for becoming physically active and quitting smoking successfully, respectively. Identity processes, encompassing identity formation, - maintenance, - change, and - loss, were detected as applicable to both physical activity and smoking, although differences were observed between the two behaviors. Characteristics such as gender, age and behavioral history emerged as relevant in shaping smoking- and physical activity-related identities.

Conclusions: Despite variances, findings suggest that the relationship between identity and behavior, including associated processes, may not fundamentally differ between health-promoting and health-compromising behaviors. Avenues for future research, including exploring causality between identity and behavior are proposed.

Registration: The study protocol associated with this scoping review was previously published in *BMJ Open* [1] and pre-registered on the Open Science Framework (<https://osf.io/hkd9c>).

INTRODUCTION

Scholars have advocated for integrating identity into behavioral theories for 35 years [2]. Identity, answers the question ‘Who am I?’, is constructed from self-perceptions of oneself. It can encompass sociodemographic characteristics (e.g., woman), societal roles (e.g., devoted friend, parent) or social classifications (e.g., smoker, fitness enthusiast) [3]. Multiple theories have since then incorporated identity as behavioral determinant. For instance, Identity Theory [4] suggests that important salient identities (e.g., healthy person) guide behavior (e.g., going for a walk at lunch). Social Identity Theory [5] proposes that significant parts of one’s identity stem from affiliations with social groups (e.g., yoga class attendee), and that this social identity can influence behavior (e.g., purchase yoga pants) through a desire to belong to the ‘ingroup’. Possible Selves Theory [6] underscores that present behavior (e.g., regular physical activity (PA)) is guided by the desire to achieve or avoid certain future identities (e.g., grand-parent (un)able to play with grand-children). In line with theory, empirical studies consistently demonstrate that identity significantly influences (health) behaviors like PA and smoking, even beyond other predictors [7–9]. To illustrate, PA-related identity gets consistently linked to PA behavior [7,10–12], and smoking-related identity to smoking and quitting behaviors [13–17].

Smoking and physical inactivity, individually and especially when co-occurring, are major risk factors for disease [18–20] and early mortality [21]. PA is a health promoting behavior which should be increased, while smoking is a health compromising behavior which should preferably be quit [22,23]. Quitting smoking has been found to facilitate PA through increased lung function [23], and increasing PA can facilitate smoking cessation by increasing quit intention [24] and reducing urges to smoke [25]. In other words, literature indicates a synergy between quitting smoking and increasing PA. Investigating whether identity influences behavior similarly for behaviors to increase versus those to abandon is therefore interesting, and the focus of this review which examines both PA and smoking cessation.

Despite substantial research, there is no comprehensive and up-to-date aggregation of knowledge regarding the identity-behavior relation in the context of PA and smoking. Earlier syntheses are outdated [26–29], focus on youth only [26], exclude physically inactive populations [27] or report limited results regarding the role of identity in smoking behavior [14]. Importantly, none focuses on and compares the relation of identity with health-enhancing (PA) versus health-compromising (smoking) behaviors. This review is the first to aggregate knowledge for both PA and smoking.

The lack of aggregation and overview of the existing knowledge may stem from variations in definitions and operationalizations of identity [9]. Addressing this, this review maps the conceptualization and operationalization of identity, and potential differences therein between PA and smoking.

This scoping review concentrates on middle-aged and older adults (> 45 years old) because research indicates longer engagement in behavior increases the likelihood of it becoming engrained in one's identity [30]. Besides, health risks of physical inactivity and smoking increase exponentially after the age of 45 [31–34], emphasizing the importance of studying this demographic when trying to understand how identity and behavior are related. The primary aim of this scoping review is to synthesize and compare how PA- and smoking-related identity are conceptualized and operationalized, and their relationship with the respective behaviors in individuals aged 45 and above.

PA- and smoking-behaviors and identities may vary depending on personal, PA- and/or smoking-related characteristics. To illustrate, men [35] and individuals with lower socioeconomic positions (SEP) [36,37] tend to be less physically active and smoke more. Additionally, older individuals [30] and those with greater nicotine addiction [15] tend to identify more strongly with smoking. Therefore, a subsidiary aim of this review is to synthesize, where applicable, the role of personal-, PA- and/or smoking-related characteristics in the relation between smoking- and PA-related identities and behaviors.

MATERIALS & METHODS

A scoping review was most fitting, allowing to comprehensively synthesize and compare findings across diverse research areas, employing diverse methodologies. The most important parts of the methodology and changes made to the original protocol are detailed here. The full methodology is detailed in our published scoping review protocol [1].

The scoping review originally had two research aims [1]. However, the methodologies for studies providing answers to the first aim varied widely, while those addressing the second aim were more uniform. To ensure comprehensive coverage of our research aims and to adequately represent the evidence from retrieved studies, we opted to conduct two separate reviews: a scoping review addressing the first aim and a systematic review addressing the second. The present scoping review aggregates and synthesizes existing knowledge about identity in the contexts of PA and smoking (see 37). The parallel systematic review examines interventions aimed at influencing PA- and smoking-related identity.

The focus on the 45+ age group in this review represents another amendment to the initial protocol. Without this restriction, it would have been challenging to attain the same level of comprehensiveness across 268 studies (see Figure 1). Lastly, another change to the original protocol is the inclusion of studies with sufficiently and insufficiently physically active individuals, rather than only insufficiently active individuals. This decision was made to avoid restricting the review to a subset of the 45+ population.

Materials and methods in this review follow guidelines outlined in Levac et al.'s [38] methodological framework for scoping reviews, and aligns with the PRISMA-ScR guidelines [39] and those by the Joanna Briggs Institute [40].

Step 1: Research questions

1. How is identity related to PA- and smoking conceptualized and operationalized in individuals aged 45 and older, and what differences and similarities exist between the two behaviors?
2. What is known about how PA- and smoking-related identity relates to PA- and smoking behavior in adults aged 45 and over, and what similarities and differences exist between the two behaviors?
3. Where applicable, what part do personal characteristics (e.g., demographics, smoking-related and PA-related) play in the relation between PA- and smoking-related identity and behavior?

Step 2: Identifying relevant studies, eligibility criteria, information sources and search

1.1 Eligibility criteria

Retrieved records were assessed against the PRISMA-ScR Concepts, Context and Participants criteria detailed in the protocol [1]. The full list of eligibility criteria can be found in Supplement 1.

1.1.1 Concepts

This scoping review includes empirical studies examining identity related to PA- and smoking on the one side and physical (in)activity and/or smoking behaviors, or precursors of behavior (e.g., intention, attitudes, motivation) on the other.

In this review, PA refers to 'bodily movements produced by skeletal muscles that require energy expenditure' [41], like walking, gardening, or exercising. Smoking behavior refers to using tobacco (any type) or electronic cigarettes. Identity refers to self-perceptions that we have of ourselves (e.g. self-identity) and based on group memberships (e.g. group identity).

Records studying concepts differing from above definitions were excluded (full list of ex-/included concepts in Supplement 2).

1.1.2 Context

The review includes published, peer-reviewed empirical studies with no restrictions regarding the publication year. Conference abstracts, book(s) chapters and commentaries were excluded, but their reference lists searched for relevant studies. To include original data only, reviews were eliminated after examining their reference lists.

1.1.3 Participants

This review includes studies with participants aged 45+ (on average) within studies investigating identity in PA and smoking. This study did not include direct involvement from patients or the public in its design, conduct, or analysis.

1.2 Identifying relevant studies, information sources and search

Following Joanna Briggs Institute guidelines [40], we employed a three-step search strategy (full details in the protocol). The search strategy was refined three times to retrieve relevant records from PubMed, PsycINFO, Embase, Emcare, Web of Science Core Collection, Wiley Cochrane Library, Psychology, Behavioural Sciences Collection and Academic Search Premier (see Supplement 3 for the search strings). Backward reference searching was done after title and abstract screening and forward reference searching after full-text screening. The initial search was carried out in December 2020 and a search update in May 2023.

Step 3: Screening and selecting studies

Once duplicates were removed, results of database searches were uploaded to ASReview [42] and Rayyan QCRI [43], as explained in the protocol. Two independent reviewers (MvV and KP) conducted two rounds of title and abstract screening, and two reviewers (EvH and KP) independently screened full-texts against eligibility criteria. Records marked as 'included' during title and abstract screening were exported to an Excel file, and their full-texts screened against eligibility criteria. Reasons for exclusion were meticulously recorded (see Figure 1). The screening manual was developed iteratively (see Anderson et al. [44]); the final version can be found in Supplement 1.

During title and abstract screening, records were categorized as appropriate for the scoping review or the systematic review on interventions (EvH). Categorization was verified during full-text screening (KP). In both phases, the second reviewer (KP) screened 10% of the records. Cohen's k [45] was substantial at the title and abstract (68.8%) and almost perfect at the full-text screening phase (85.4%) [46]. Disagreement was resolved through discussion among reviewers or consultation with an additional co-author (EM).

Step 4: Data charting

Two reviewers (EvH and KP) independently charted data from full-texts in Excel, extracting key information: study details (author(s), publication year, language, studied behaviors (PA and/or smoking), country), aim(s), methodology (design, measures, participants, procedure, analyses), findings related to the scoping review concepts, and study limitations. When available, information about study participants' demographic characteristics (age, gender, body mass index (BMI), ethnicity, SEP, marital status), PA-related characteristics (amount and type of PA) and smoking-related characteristics (smoking heaviness, smoking years, smoking onset, smoking type, previous quit attempts, nicotine dependence) were also extracted. Where required, authors of included studies were contacted to request full-texts or missing/additional information.

Step 5: Collating, summarizing and reporting the results

None of the included articles studied smoking and physical activity together, therefore the evidence was summarized separately for both health behaviors. First, we compiled descriptive numerical summaries of study characteristics. Second, we compiled descriptive numerical summaries of how identity was conceptualized and operationalized (RQ1), and organized findings in three sections: 1) terminology related to identity, 2) identity labels employed, which represent concrete expressions of identity, and 3) tools used to measure identity. Similarities and differences herein between PA and smoking were identified and synthesized. Within the section on identity terminology, we classified terms as 'individual level', reflecting self-perceptions of oneself, or 'interpersonal level', referring to self-perceptions as (non)member of a certain group or social category, based on degree of identification with others from that group. Third, we synthesized the relationship between PA- and smoking-related identity and behavior (RQ2), and the role of personal characteristics (RQ3). We organized these findings into key themes, and compared similarities and differences between PA and smoking. ChatGPT was used to correct spelling and grammatical errors and to shorten the manuscript.

Step 6: Consultation

As part of their methodological framework for scoping reviews, Levac et al. [38] recommend a consultation phase. This phase allows authors to garner feedback and to gain additional insights on the findings of the review (see also 48). An early version of this review was presented to a group of eleven Behavioral Scientists and Health Psychologists with substantial expertise in (health) behavior change (see Acknowledgment section). Next, a revised version was presented to three experts on identity in the context of health behaviors (RW, BvdP, CvL, see Acknowledgment section). In both rounds, experts were asked to reflect on the content and structure of the present review, which helped validate the findings, and clarify and structure the narrative.

RESULTS

The two systematic search rounds across 11 databases yielded 8805 records. Following the removal of duplicates ($n = 3004$), we screened 5801 titles and abstracts, and subsequently assessed 365 full-text articles for eligibility. Among these, 45 articles fulfilled the eligibility criteria and were incorporated into this review. See Figure 1 for details on the in-/exclusion process.

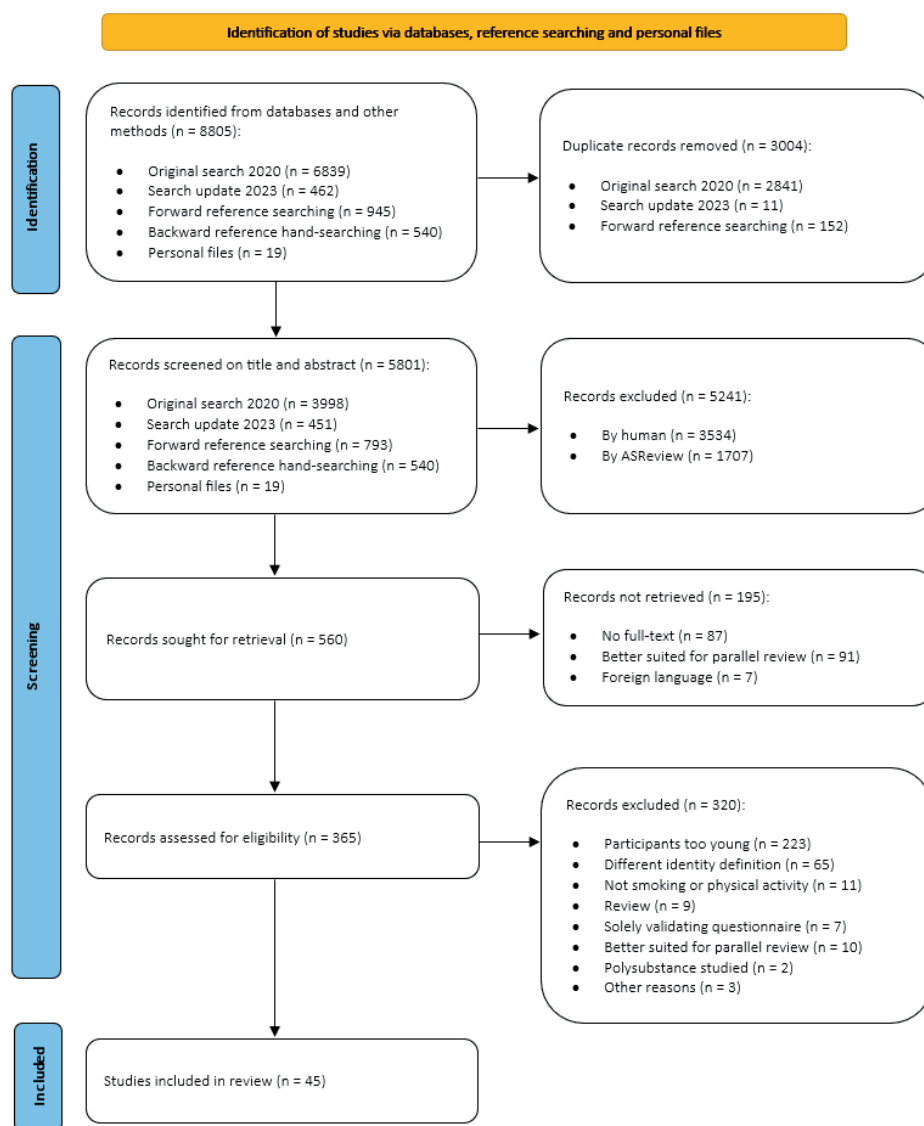


Figure 1 - PRISMA flowchart

1. Description of the included studies

Most included studies focused on PA ($n = 35$) rather than smoking ($n = 10$), with none examining both health behaviors. There was no apparent difference in research design, participants' background, or country of origin between studies focused on PA versus smoking. The only notable difference was that only studies on PA employed possible future-self methodologies. See Table 1 for an overview of study characteristics.

Table 1. Summary of the characteristics of included studies (n = 45)

Characteristics		Number of studies	References
Behavior	Physical activity	35	Bailis 2008; Dionigi 2022; Eynon 2016; Hansen 2013; Hardcastle 2005; Havitz 2013; Hays 2005; Hays 2010; Huffman 2022; Jin 2021; Kenter 2015; Kirby 2013; Kullman 2023; Leavy 2010; Liechty 2012; Lin 2022; Lorentzen 2007; Morgan 2021; Murray 2022; Pentecost 2011; Perras 2015; Perras 2016; Rhodes 2023; Rossing 2016; Schumacher 2019; Sheehy 2016; Springer 2013; Son 2009; Son 2011; Strachan 2010; Tierney 2011; Whaley, 2003; Whaley 2002; Whaley 2005; Yoshigai 2023
	Smoking	10	Brown, 1996; Callaghan 2020; Farrimond 2017; Leas 2014; Meijer 2018; Notley 2018; Rodriguez 2019; Smith 2020; Vangeli 2010; Vangeli 2012
Design	Cross-sectional	33	<i>Physical activity:</i> Dionigi 2022; Eynon 2016; Hansen 2013; Havitz 2013; Hays 2010; Jin 2021; Kenter 2015; Kirby 2013; Kullman 2023; Leavy 2010; Liechty 2012; Lin 2022; Lorentzen 2007; Murray 2022; Pentecost 2011; Perras 2015; Rhodes 2023; Sheehy 2016; Son 2009; Son 2011; Springer 2013; Strachan 2010; Tierney 2011; Whaley, 2003; Whaley 2002; Yoshigai 2023 <i>Smoking:</i> Brown, 1996; Farrimond 2017; Leas 2014; Notley 2018; Smith 2020; Vangeli 2010; Vangeli 2012
	Longitudinal (study duration up to 5 years)	9	<i>Physical activity:</i> Bailis 2008; Hardcastle 2005; Hays 2005; Huffman 2022; Perras 2016; Rossing 2016; Schumacher 2019; Whaley 2005 <i>Smoking:</i> Callaghan 2020
Country	Pre-post	3	<i>Physical activity:</i> Morgan 2021 <i>Smoking:</i> Meijer 2018; Rodriguez 2019
	USA	17	<i>Physical activity:</i> Hays 2005; Hays 2010; Huffman 2022; Jin 2021; Kirby 2013; Schumacher 2019; Sheehy 2016; Son 2009; Son 2011; Springer 2013; Strachan 2010; Whaley 2003; Whaley 2002; Whaley 2005 <i>Smoking:</i> Brown, 1996; Leas 2014; Rodriguez 2019
	UK	8	<i>Physical activity:</i> Eynon 2016; Hardcastle 2005; Pentecost 2011; Tierney 2011 <i>Smoking:</i> Farrimond 2017; Notley 2018; Vangeli 2010; Vangeli 2012

Table 1. Summary of the characteristics of included studies (n = 45) (continued)

Characteristics	Number of studies	References
Australia	3	<i>Physical activity:</i> Dionigi 2002; Murray 2022 <i>Smoking:</i> Smith 2020
Canada	8	<i>Physical activity:</i> Bailis 2008; Havitz 2013; Kullman 2023; Liechty 2012; Morgan 2021; Perras 2015; Perras 2016; Rhodes 2023
Australia & Canada	1	<i>Smoking:</i> Callaghan 2020
The Netherlands	2	<i>Physical activity:</i> Kenter 2015 <i>Smoking:</i> Meijer 2018
Japan	1	<i>Physical activity:</i> Yoshigai 2023
China	1	<i>Physical activity:</i> Lin 2022
Sweden & Ireland	1	<i>Physical activity:</i> Leavy 2010
Norway	3	<i>Physical activity:</i> Hansen 2013; Lorentzen 2007; Rossing 2016
Explore relationship between identity and precursors of behavior	6	<i>Physical activity:</i> Leavy 2010; Lorentzen 2007; Morgan 2021; Yoshigai 2023 <i>Smoking:</i> Farrimond 2017; Vangeli 2010
Explore relationship of identity and behavior	17	<i>Physical activity:</i> Dionigi 2022; Hardcastle 2005; Kirby 2013; Liechty, 2012; Perras 2015; Perras 2016; Rhodes 2023 ; Springer 2013; Whaley 2002 <i>Smoking:</i> Brown, 1996; Kullman 2023 ; Leas 2014; Meijer 2018; Notley & Collins 2018; Rodriguez 2019;2018; Smith 2020; Vangeli 2012
Explore relationships between identity, (precursors of) behavior, and other psychological, social, cognitive, environmental or biological variables	22	<i>Physical activity:</i> Bailis 2008; Eynon 2016; Hansen 2013; Havitz 2013; Hays 2005; Hays 2010; Huffman 2022; Jin 2021; Kenter 2015; Lin 2022; Murray 2022; Pentecost 2011; Rossing 2016; Schumacher 2019; Sheehy 2016; Son 2009; Son 2011; Strachan 2010; Tierney 2011; Whaley, 2003; Whaley 2005 <i>Smoking:</i> Callaghan 2020
Participants		
Health status		
Patient population	1	<i>Physical activity:</i> Sheehy 2017
Parkinson's disease		
Breast cancer	1	<i>Physical activity:</i> Murray 2022
Heart failure	1	<i>Physical activity:</i> Tierney 2011

Table 1. Summary of the characteristics of included studies (n = 45) (continued)

Characteristics		Number of studies	References
	Multiple chronic conditions (e.g., asthma and arthritis)	2	<i>Physical activity</i> : Bailis 2008; Pentecost 2011
	No underlying medical conditions impairing engagement in physical activity ^a	2	<i>Physical activity</i> : Morgan 2021; Schumacher 2019
	Healthy participants and people with underlying health conditions	13	<i>Physical activity</i> : Eynon 2016; Hansen 2013; Hardcastle 2005; Hays 2005; Hays 2010; Huffman 2022; Jin 2021; Kenter 2018; Leavy 2010; Liechty 2012; Strachan 2010; Whaley 2005 <i>Smoking</i> : Meijer 2018
	Unspecified	25	<i>Physical activity</i> : Dionigi 2022; Havitz 2013; Kirby 2013; Kullman 2023; Lin 2022; Lorentzen 2007; Perras 2015; Perras 2016; Rhodes 2023; Rossing 2016; Son 2009; Son 2011; Springer 2013; Whaley 2003; Whaley 2002; Yoshigai 2023 <i>Smoking</i> : Brown, 1996; Callaghan 2020; Farrimond 2017; Leas 2014; Notley 2018; Rodriguez 2019; Smith 2020; Vangeli 2012; Vangeli 2010
Gender	Women only	8	<i>Physical activity</i> : Hardcastle 2005; Hays 2005; Hays 2010; Kirby 2013; Murray 2022; Rossing 2016; Whaley, 2003; Yoshigai 2023
	Men only	1	<i>Physical activity</i> : Liechty 2012
	Men and women (~50% each)	17	<i>Physical activity</i> : Eynon 2016; Hansen 2013; Huffman 2022; Kullman 2023; Leavy 2010; Rhodes 2023; Sheehy 2016; Springer 2013; Whaley 2005 <i>Smoking</i> : Brown, 1996; Callaghan 2020; Farrimond 2017; Leas 2014; Meijer 2018; Rodriguez 2019; Vangeli 2010; Vangeli 2012
	More women than men	15	<i>Physical activity</i> : Bailis 2008; Havitz 2013; Jin 2021; Kenter 2015; Lorentzen 2007; Lin 2022; Morgan 2021; Pentecost 2011; Perras 2015; Perras 2016; Schumacher 2019; Smith 2020; Son 2009; Son 2011; Strachan 2010
	More men than women	1	<i>Physical activity</i> : Tierney 2011
	Unknown	3	<i>Physical activity</i> : Dionigi 2002; Whaley 2002 <i>Smoking</i> : Notley 2018
Smoking status	Currently smokes	3	Callaghan 2020; Meijer 2018; Leas 2014
	Tobacco E-cigarettes and tobacco ^b	1	Farrimond 2017

Table 1. Summary of the characteristics of included studies (n = 45) (continued)

Characteristics	Number of studies	References
Quit smoking but relapsed	1	Notley 2018; Rodriguez 2019
No longer smokes	5	Brown, 1996; Rodriguez 2019; Smith 2020; Vangeli 2012; Vangeli 2010
Physical activity level and type	1	Lin 2022
Guozhuang (folk) dance	1	
Fitness center/class	11	Eynon 2016 ^c ; Hardcastle 2005 ^c ; Hays 2005; Hays 2010; Morgan 2021 ^c ; Pentecost 2011 ^c ; Rossing 2016; Sheehy 2016; Springer 2013; Strachan 2010; Whaley 2002; Whaley 2005
Not specified/variety types (level and intensity unspecified)	12	Bailis 2008; Hansen 2013; Havitz 2013; Jin 2021; Leavy 2010; Liechty 2012; Lorentzen 2007; Murray 2022; Tierney 2011; Son 2009; Son 2011; Whaley, 2003
Any bodily movement (including household chores or gardening)	3	Huffman 2022; Kenter 2015; Yoshigai 2023
Competitively	1	Kirby 2013
Various sports (including long distance running, triathlon, gymnastics)	1	Dionigi 2022
Leisurely and competitively	1	Kullman 2023
Running	4	Perras et al, 2015; Perras 2016; Rhodes 2023; Schumacher 2019
Moderate to vigorous PA (type unspecified)		

Notes. For conciseness purposes, only the first author of each publication is mentioned in this table.

a. Having an underlying health condition was an exclusion criterion for these studies.

b. 84% only vaping, 16% vaping and smoking, 95% vaping daily

c. Participants in these studies attended gym sessions and classes or swimming classes within the scope of an exercise referral program

2. Conceptualization and operationalization of PA- and smoking related identity

2.1 Identity terminology

Across studies, eight identity constructs were classified as individual level, and two as interpersonal level. Despite nuances and variation in terminology used, there appears to be significant overlap, e.g., the individual level term 'self-identity' resembles 'self-definition', 'self-schema', 'self-concept' and 'self-perceptions'. Similarly, the interpersonal-level terms 'social identity', 'group identity' and 'collective self-esteem' were used almost interchangeably. The terms 'possible selves', 'role identity' and 'integrated regulation' at the individual level were distinct from the others, and therefore placed in a separate category. An overview of the identity terminology used in included studies is presented in Table 2.

Summary of findings and similarities and differences between PA and smoking. The terminology used in both PA- and smoking studies was diverse but associated definitions presented much overlap. There was more consistency in the terms used in studies on smoking compared to studies on PA, namely 'self-identity' at the individual level and 'social identity' at the interpersonal level.

Table 2 – Overview of identity-related terminology used in included studies (n = 45)

Identity constructs		Number of studies	References
Individual level	Similar definitions	29	<i>Physical activity:</i> Dionigi 2002; Eynon 2016; Hardcastle 2005; Havitz 2013; Hansen 2014; Huffman 2022; Jin 2021; Kenter 2015; Lietchy 2014; Lorentzen 2007; Murray 2022; Perras 2015; Perras 2016; Pentecost 2011; Rhodes 2023; Rossing 2014; Schumacher 2019; Son 2009; Son 2011; Springer 2013; Strachan 2010 <i>Smoking:</i> Callaghan 2021; Farrimond 2017; Leas 2015; Meijer 2018; Notley 2018; Smith 2020; Vangeli 2012; Vangeli 2010
	Self-identity (Self-perceptions of the self within the social and physical environment – definition from Identity Theory [41])	1	<i>Smoking:</i> Rodriguez 2019
	Self-concept (Subjective importance of the behavior to the conception of self – definition from article)	4	<i>Physical activity:</i> Leavy 2010; Sheehy 2016; Whaley 2005 <i>Smoking:</i> Brown 1996
	Self-perceptions (Self-perceptions of ourselves and our abilities – theoretical ground of definition not specified – definition from the Cognitive approach to the self-concept [48] and Self-Perception Theory [49])	1	<i>Physical activity:</i> Huffman 2022
	Role identity (How behavior has been integrated in one's identity – definition from article)	3	<i>Physical activity:</i> Hays 2005; Hays 2010; Morgan 2021 <i>Physical activity:</i> Hays 2005; Whaley 2002
Distinct definitions	Self-definition (Self-views about the self – definition from article)	1	<i>Physical activity:</i> Huffman 2022
	Self-schema(ta) (Information and beliefs about the self which guide perceptions of the world and processing of self-related information – definition from the Self-Schema Model [50])	7	<i>Physical activity:</i> Bailis 2008; Hardcastle 2005; Kenter 2015; Kullman 2023; Perras 2015; Perras 2016 <i>Smoking:</i> Vangeli 2012
	Integrated regulation ((The highest form of extrinsic motivation in which behavior is self-congruent – definition from Self-Determination theory [51])	7	<i>Physical activity:</i> Kenter 2015; Perras 2015; Perras 2016; Sheehy 2017; Whaley 2003; Whaley 2005; Yoshigai 2022

Table 2 – Overview of identity-related terminology used in included studies (n = 45) (continued)

Identity constructs		Number of studies	References
Interpersonal level	Similar definitions	16	<i>Physical activity</i> : Bailis 2008; Dionigi 2002; Havitz 2013; Kenter 2015; Kullman 2023; Lietchy 2014; Lin 2022; Pentecost & Taket 2011; Rossing 2014; Son 2009; Strachan 2010 <i>Smoking</i> : Farrimond 2017; Notley 2018; Smith 2020; Vangeli 2012
	Collective self-esteem ((Self-evaluation as a member of a social group – definition from Crocker & Luthanen [52])	1	<i>Physical activity</i> : Bailis 2008

Note. For conciseness purposes, only the first author of each publication is mentioned in this table.
a. In this study, the term ‘role identity’ was used to refer to what other studies using the same measurement device referred to as ‘self-identity’, and was therefore placed within the individual level category.

2.2 Identity labels

An overview of identity labels employed in included studies is presented in Table 3. Included studies reported a variety of identity labels specific to either PA or smoking, which illustrates variety in the expression of identity in relation to PA and smoking.

In studies on PA, a greater number of identity labels were identified on the individual level than on the interpersonal level. Individual-level labels typically leaned towards physical inactivity (e.g., 'not a gym person'), physical capability (e.g., 'someone who is physically inclined'), or PA-intensity, with a distinction between general PA such as walking or doing household chores (e.g., 'someone who keeps physically active') and exercise (e.g., 'runner'). Overall, 'exercise self-identity' was the most frequently used label, followed by 'physical activity identity'. Although some labels reflected the type of sports one engages in (e.g., 'volleyball player'), interpersonal-level identity ones generally reflected a sense of belonging to a group engaging in certain PA (e.g., 'runner group identity').

In smoking studies, identity labels predominantly revolved around smoking and not smoking, at both the individual level (e.g., 'smoker self-identity', 'ex-smoker') and interpersonal level (e.g., 'smoker social identity', 'nonsmoker social identity'). Individual-level labels often depicted internal negotiations when behavior and identity did not (fully) align, such as indicating behavior change ('someone who does not now smoke') or attempts at behavior change ('smoker trying to quit smoking'). Some labels highlighted complex relationships with the smoking-related identity, including when people identified as smokers but enforced abstinence ('smoker self-forced to abstain'), identified as smokers only in specific social settings ('social smoker'), or chose to quit smoking while still identifying as smokers ('smoker who has chosen to no longer smoke'). Some even actively denied their smoker identity while continuing to smoke ('non-identifying smoker'). On the interpersonal level, identity labels were less varied diverse, did not include negotiations, and generally reflected identification with specific social groups (e.g., 'smoker social identity'). Furthermore, the label 'vaper' underscored the existence of a distinct self- and social vaping identity among e-cigarettes users, separate from an identity related to smoking tobacco.

Summary of findings and similarities and differences between PA and smoking. In studies on smoking, identity labels mainly reflected a smoking/non-smoking dichotomy and highlighted negotiations in identity expression misaligned with behavior. Conversely, in studies on PA, identity labels extended beyond the engagement/non-engagement dichotomy and reflected physical inactivity, PA capabilities, PA intensity and belonging to a group engaging in certain PA.

Table 3 – Overview of identity labels employed in included studies (n = 45)

Behavior	Identity level	Identity label	Number of studies	References
Smoking	Individual level	Smoker	6	Brown 1996; Callaghan 2021; Meijer 2018; Notley 2018; Vangeli 2010; Vangeli 2012
		Vaper	1	Farrimond 2017
		Non-identifying smoker	1	Leas 2015
		Addicted smoker	1	Smith 2020
		Relapsed smoker	1	Notley 2018
		Smoker self-forced to abstain	1	Vangeli 2012
		Smoker trying to quit	1	Callaghan 2021
		Social smoker (i.e., who smokes only in social situations)	1	Smith 2020
		Smoker who has chosen to no longer smoke	1	Callaghan 2021
		Nonsmoker	7	Brown 1996; Callaghan 2021; Meijer 2018; Notley 2018; Rodriguez 2019; Vangeli 2010; Vangeli 2012
		Someone who does not now smoke	1	Notley 2018
		Ex-smoker	2	Vangeli 2012; Vangeli 2010
		Smoker social identity	2	Notley 2018; Vangeli 2012
		Vaper / Vaping social identity	1	Farrimond 2017
Interpersonal level	Related to smoking	Nonsmoker social identity	2	Brown 1996; Vangeli 2012
		Team stop-smoker	1	Vangeli 2012
	Related to not smoking			

Table 3 – Overview of identity labels employed in included studies (n = 45) (continued)

Behavior	Identity level	Identity label	Number of studies	References
Physical activity	Individual level	Related to physical activity	7	Hansen 2014; Leavy 2010; Lorentzen 2007; Perras 2015; Perras 2016; Rhodes 2023; Strachan 2010
		Physically active self	2	Springer 2013; Tierney 2011
		Someone who keeps physically active	1	Whaley 2002
		Active person	2	Springer 2013; Whaley 2002
		Exercise identity	12	Eynon 2018; Hardcastle 2005; Hays 2005; Huffman 2022; Murray 2022; Pentecost 2011; Rossing 2016; Schumacher 2019; Sheehy 2017; Son 2009; Son 2011; Whaley 2002
		Runner	1	Kullman 2023
	Interpersonal level	Volleyball player	1	Kirby 2013
		Athletic identity ^a	1	Sheehy 2017
		Functional exerciser	1	Leavy 2010
		Physically capable person	2	Pentecost 2011; Sheehy 2017
		Someone who is physically inclined	1	Whaley 2002
		Not a gym person	1	Tierney 2011
	Related to physical inactivity	Not a sporty person	1	Tierney 2011
		Not a real athlete	1	Rossing 2016
		PA social identity	2	Rossing 2016; Sheehy 2017
		Sports social identity	1	Lin 2022
	Related to physical activity	Social exerciser	1	Jin 2021
		Volleyball player	1	Kirby 2013
		Runner group identity	1	Kullman 2023

Notes. For conciseness purposes, only the first author of each publication is mentioned in this table. Certain labels were used in multiple studies.

a. In the study using this identity label (Sheehy et al., 2017), the term athletic identity is used in relation to leisure exercise, not (competitive) sports as might be deducted from the athletic component of the identity label.

2.3 Identity measurement

Identity measurement involved quantitative and qualitative methods, with various approaches. An overview of tools used to measure identity in included studies is presented in Table 4.

Qualitative methodologies were used in both studies on PA and smoking. Identity-related themes emerged from participant interviews or focus groups, with three approaches: 1) asking participants to describe their perceptions and experiences related to PA and/or smoking, and extracting identity-related themes during data analysis, 2) asking questions about identity in relation to PA or smoking directly and 3) asking participants to describe possible future selves related to PA, triggering reflection about their identity and the extent to which certain behaviors were in line with it, and extracting identity-relevant data during data analysis.

Quantitative methodologies were also used in both studies on PA and smoking, with distinct variations. Validated questionnaires, measurement tools priorly used in research and methodologies related to possible future selves were only used in studies on PA, while single-item questionnaires were exclusively used in studies on smoking.

In the majority of PA studies using the Exercise Identity Scale [53], the scale was adapted to ask about PA rather than exercise, i.e., ‘I consider myself an exerciser’ was adapted to ‘I consider myself a physically active person’. This adaptation was based on the preference of middle-aged/older individuals, who found ‘physical activity’ more representative of the type and intensity of their PA than ‘exercise’ [54]. Importantly, this adaptation was not found to affect internal consistency of the questionnaire [54]. This preference was confirmed in several reviewed studies with different research designs [55–57].

One PA study [58] compared two validated questionnaires, the Exercise Identity Scale and the Behavioral Regulation in Exercise Questionnaire version 3 (BREQ-3)(which measures extrinsic and intrinsic motivation for engaging in a behavior). The study found both questionnaires to be valid and reliable for measuring PA-related identity. However, when using the Exercise Identity Scale, scholars interested in measuring PA-identity specifically are recommended to use only the ‘role identity’ subscale.

Summary of findings and similarities and differences between PA and smoking. Qualitative methods were consistently employed in both studies on PA and smoking. However, distinct variations emerged in the quantitative measurement tools for PA- and smoking-related identity.

Table 4 - Overview of identity measurement tools used in included studies (n = 45)

Characteristics		Number of studies	References
Qualitative	Interviews or focus groups	16	<i>Physical activity:</i> Dionigi 2002; Eynon 2016; Hays 2005; Jin 2021; Kirby 2013; Kullman 2023; Leavy 2010; Lietchy 2014; Nottley 2018; Pentecost 2011; Rossing 2014; Springer 2013; Tierney 2011; Whaley 2005; Yoshigai 2023 <i>Smoking:</i> Brown 1996
Quantitative	Validated questionnaires	5	<i>Physical activity:</i> Hardcastle 2005; Kenter 2015; Sheehy 2016; Whaley 2002 <i>Smoking:</i> Vangeli 2012
		2	Participants asked about self-views in relation to smoking and PA during interview (e.g., 'Do you view yourself differently now that you are not smoking compared to when you were smoking?').
		10	Participants asked to describe possible future selves related to smoking or PA (approach specific to studies on possible future selves). Exercise Identity Scale [53]
		1	<i>Physical activity:</i> <i>Original 9-item scale:</i> Murray 2022; Schumacher 2019; Son 2009; Son 2011 <i>Modified version:</i> Huffman 2022 (PA identity*); Lo-rentzen 2007 (PA-identity* and 4-item version); Perras 2015 (PA-identity*); Perras 2016 (PA-identity*); Rhodes 2023 (Only the role identity sub-scale); Strachan 2010 (PA-identity*) <i>Physical activity:</i> Huffman 2022
		1	Behavioral Regulation in Exercise Questionnaire (BREQ_3), including subscale for integrated regulation [59, 60]
		1	Modified Involvement Scale (of which two sub-scales are 'identity affirmation' (a proxy for social PA identity) and 'identity expression' (a proxy for PA self-identity)) [61]
		1	Social Identity Questionnaire for Sport (SIQS) by Bruner & Benson (2018)
		1	Physical Activity Self-Definition Model (PASD) by Kendzierski et al. [63]

Table 4 - Overview of identity measurement tools used in included studies (n = 45) (continued)

Characteristics		Number of studies	References
Quantitative	Questionnaires used in prior research	4	<i>Physical activity</i> : Perras 2015; Perras 2016; Whaley 2003; Whaley 2005
	Possible Selves Instrument [64]		
	Collective self-esteem scale [52]	1	<i>Physical activity</i> : Ballis 2008
	Exercise Schemata Scale [65,66]	1	<i>Physical activity</i> : Whaley 2002
	Exercise Self-Definition Scale [56]	2	<i>Physical activity</i> : Hays 2005; Hays 2010
Self-developed measurement tool	Subjective Importance of Smoking (SIMS) (Final validation phase of the questionnaire)	1	<i>Smoking</i> : Rodriguez 2019
	Raking of statements reflecting personal views and understanding including identity-related statements: 'To stop vaping would be to lose part of myself', 'I'm proud to be labelled a 'vaper'', 'I'm not a vaper, I'm just someone who happens to use e-cigarettes', 'Degree to which four statements were self-descriptive for own physical activity (e.g., 'Being physically active is a part of being the person I am')	1	<i>Smoking</i> : Farrimond 2017
		1	<i>Physical activity</i> : Hansen 2014
	Single-item questionnaire	1	<i>Smoking</i> : Vangeli 2010
	Self-labelling as a response to the question: 'How do you think of yourself?' with answer options 'Definitely a nonsmoker', 'A reluctant nonsmoker', 'A smoker who is not smoking',	1	
	Agreement with statements pertaining to smoker self-identity (i.e., 'I see myself as a person who smokes') and nonsmoker self-identity (i.e., 'I would rather be a nonsmoker').	1	<i>Smoking</i> : Meijer 2018
	Answer to the question: 'How would you describe yourself now?' Answer options: 'A smoker trying to quit', 'A smoker who has chosen to no longer smoke', 'A non-smoker' or an 'ex-smoker'	1	<i>Smoking</i> : Callaghan 2021
	Yes/No answer to the question: 'Do you consider yourself a smoker?'	1	<i>Smoking</i> : Leas 2015

Notes. For conciseness purposes, only the first author of each publication is mentioned in this table. Some studies used multiple measurement tools.

*'PA-identity' indicates that a modified version of the Exercise Identity Scale was used. Items inquired about 'physical activity' rather than 'exercise'.

3. The association between identity and behavior in the context of PA and smoking

Four themes related to the relationship between PA-/smoking-related identity and behavior emerged during data analysis: 1) the direct relationship between PA-/smoking-related identity and behavior, 2) the indirect relationship between the two, 3) identity processes related to PA and smoking and 4) the relationship between PA-/smoking-related identity and personal characteristics. These themes, their interconnections and the associated section of the narrative summary in which they are presented are visually presented in Figure 2. Each section ends with a synthesis of the findings and of the similarities and differences between PA and smoking. An overview of all identified similarities and differences between PA and smoking is presented in Table 5.

3.1 Direct relationship between PA-/smoking-related identity and behavior

Direct relationship between identity and behavior. For PA, all but one study [67] found a direct relation between the strength of PA-related identity and PA behavior. This relation was present for identity on both the individual- and interpersonal-level, regardless of whether individuals held identities related to physical inactivity, physical capabilities or PA-intensity, and for a wide range of PAs (i.e., dancing [68], running [69], competitive sports (e.g., volleyball, triathlon, aerobics, archery) [70,71] and leisure time PA [70,72–75]). Specifically, in all but the one study, a strong identity reflecting physical inactivity or weaker PA-related identity was linked to lower engagement in PA, while a stronger PA-related identity was related to higher duration, intensity [68,74–78] and frequency of PA [54,56,58,68,70,72–86]. The relationship persists across healthy individuals and patient populations, even after considering factors like age, gender, SEP, marital status and health status [58,69,72,76,77,79,85,87,88]. However, Hays et al. [67] found no significant relationship between exercise self-definition and exercise adoption, after controlling for age, race, perceived health, mobility difficulties and exercise levels. None of the studies examined the relationship between PA-related identity and smoking behavior.

Studies on smoking consistently showed a direct association between the strength of smoking-related identity and smoking behavior. This association applied to both tobacco [89–95] and e-cigarette use [96], at both the individual and interpersonal level. Specifically, holding a smoker self- or social identity was linked to continued smoking [89,90,92–95], while identifying as ‘nonsmoker’ or ‘ex-smoker’ was positively linked to quitting [92] and continued abstinence [89,90,92,93]. Notably, a stronger nonsmoker self-identity was more strongly associated with quitting than a weaker smoker self-identity [92]. In the study on e-cigarettes [96], a strong self- or social identity as ‘vapers’ and a neutral stance or even rejection of a vaping identity were positively paired with consumption of e-cigarettes. However, included studies did not extend to other forms of smoking (e.g., cigars, cigarillo’s), or

smoking behaviors like intensity, duration and frequency. No study examined the relationship between smoking-related identity and PA-behavior.

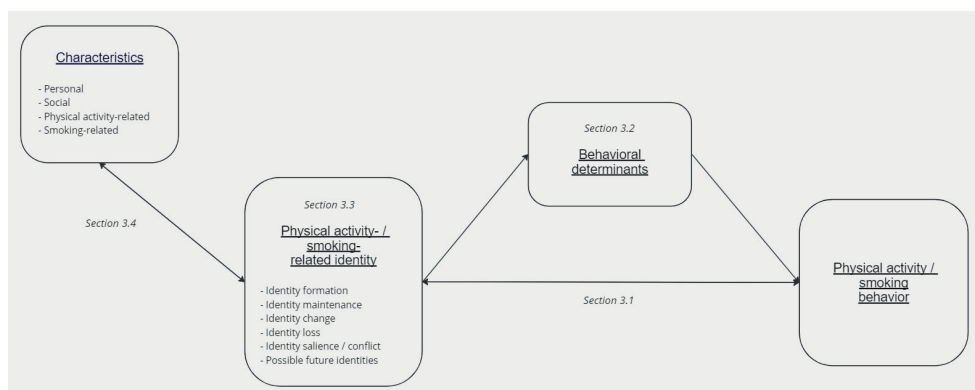


Figure 2 - Visual representation of the association between PA-/smoking-related identity and behavior established from findings of included studies, including the number of the sub-section in which the theme is addressed in the narrative summary.

Identity as strong(est) predictor of behavior. Several studies highlighted PA-related identity to be the strongest (albeit not only) predictor of PA. For example, Rhodes et al. [69] found that PA social identity remained the strongest predictor of changes in intention and actual PA during the COVID-19 pandemic, even after considering relevant factors like perceived capability to engage in PA and behavioral regulation. Similarly, Hansen et al. [76], found PA-related self-identity to be the strongest predictor of PA compared to weight, self-efficacy for performing PA, perceived control over engagement in PA, social support from family and friends in performing PA, and community attributes (e.g., facilities). Notably, Whaley and Schrider [97] found that PA-related identity and perceived skills predicted exercise initiation and maintenance. Furthermore, possessing a PA-identity and motivation to engage in PA, along with and expecting benefits, were found to help overcome constraints to engage in PA [74].

For smoking, Callaghan et al. [90] revealed that smoking-related identity ranked second strongest in predicting relapse, behind past quit duration, post-quit urges to smoke, abstinence self-efficacy, enjoyment of smoking, and perceived importance of smoking to one's life.

Relationship between identity and behavior endures over time. The positive relationship between PA-related identity and behavior was found to endure over time [56,58,69,79]. To illustrate, Huffman et al. [58] observed a persistent relation between PA-related identity and increased engagement in PA after controlling for the four weeks between measurements.

Another study [79] found that collective self-esteem, reflecting social PA-related identity, remained significantly associated with PA over a period of 6 years. Similarly, a quantitative longitudinal study found that the higher the baseline PA, the stronger the PA-related social and self-identity at 6-month follow-up [56]. However, a retrospective study conducted during the COVID-19 pandemic indicated a weakening of post-pandemic PA-related self- and social identity, following two years of limited PA due to governmental protection measures [69]. Moreover, one study with overweight and obese adults revealed PA-related identity was no longer linked to PA levels six months after the initial increase of PA [78]. Nevertheless, the majority of studies support a lasting relationship between PA-related identity and behavior.

Studies on smoking revealed a persistent association between smoking-related identity and behaviors. To illustrate, one study found that a nonsmoker self-identity at baseline was strongly associated with attempting to quit one year later [92]. Moreover, Callaghan et al. [90] found that former smokers identifying as nonsmokers or ex-smokers at baseline were less likely to have relapsed one year later than those still identifying with smoking at follow-up. This remained true after considering sociodemographic variables, smoking urges, quit attempt duration, smoking enjoyment, and perceived importance of smoking to one's life.

Relationship between past and future behavior and identity. Studies indicated a positive association between PA-identity and past PA, and between possible future identities and current behavior. To illustrate, individuals with a history of intensive PA tended to have stronger current PA-related identity [54,57,82,85,98], and both feared and hoped-for possible future selves were found to guide PA behavior in the present [83,84,86,97,98]. However, difficulty envisioning hoped-for or feared PA-self can hinder engagement in PA [99]. Furthermore, perceiving a physically active possible future self as important, likely and attainable was related to a stronger PA-identity, and having a greater number of PA-related possible future selves was positively associated with stronger PA-identity [84].

Studies on smoking did not examine the association between current smoking-related identity and past smoking behavior or examine possible future selves, leaving gaps in the current knowledge.

Difference in association with behavior for individual- versus interpersonal-level identity. The association between engagement in PA and PA-related identity exists at both individual and interpersonal levels of identity, yet it is unclear for which level the association is strongest. As an example, while Liechty et al. [73] found that individual and interpersonal level PA-related identities are equally important for PA behavior, Havitz et al. [72] reported that social PA-identity had a stronger association with leisure time PA.

Studies on smoking did not examine differences in how individual- versus interpersonal-level identity relates to behavior.

Summary of findings and similarities and differences between PA and smoking. Studies consistently showed a direct enduring relationship between PA-related identity and PA-behavior, and between smoking-related identity and smoking behavior, for both individual and interpersonal levels of identity. While all studies on smoking reported this association, a singular PA study reported a statistically non-significant relationship between identity and behavior. For PA, identity is associated with various types, intensities, durations and frequencies of PA, while for smoking, identity was primarily linked to smoking type and the binary distinction of smoking vs. not smoking. PA-related identity ranked as strongest predictor of PA-behavior whereas smoking-related identity ranked as second strongest predictor of smoking behavior, albeit in only one study. PA studies revealed relationships between past behavior and current identity, as well as future identity and current behavior, while this was not researched in studies on smoking. Whether individual or interpersonal-level identity is more strongly associated with behavior remains unclear for both behaviors. Identified similarities and differences are summarized in Table 5.

3.2 Indirect relationship between PA-/smoking-related identity and behavior

PA-related identity is indirectly related to PA through a positive association with behavioral determinants. For example, strong PA-related identity encourages prioritizing and planning PA [54,55,75,81,100], greater intention to engage in PA [69,87], expressing and maintaining commitment to exercising regularly [55,100,101], being confident about own physical abilities [56,73,81,82], perceiving and valuing the health benefits of PA [56,73,82,85,100,101] and employing strategies to engage in PA despite constraints (e.g., lacking facilities) [73,74,81] which, in turn, facilitate engagement in PA. Furthermore, in two studies [85,102], stronger PA-identity was related to greater readiness for behavior change, and subsequently greater chances of engaging in PA, an association which remained significant after controlling for age, gender, BMI, country of origin and education [102].

Additionally, possible future selves play a role in the relationship between PA-related identity and behavior, but it is unclear whether they influence PA through the activation of a PA-related identity [84] or whether a PA-related identity prompts the formation of potential PA future selves, thereby promoting PA engagement [97].

Smoking-related identity and behavior were also found to have an indirect relationship. For example, negative emotions while smoking mediated the association between identifying as smoker at baseline and continued smoking abstinence 24 weeks later [103]. Smith's research [104] suggests that the relationship between an identity as smoker and a successful quit attempt is influenced by seriousness about quitting. Additionally, Vangeli and West

[95] propose an indirect relationship between social smoking-related identity and smoking, influenced by factors like sense of accomplishment, motivation to stay abstinent and determination to set a positive example. This study also suggests an indirect relationship between a weak identity as nonsmoker and relapse, influenced by positive perceptions of smoking.

No study on smoking looked at possible future selves, leaving a gap in understanding their potential role in the relation between smoking-related identity and smoking.

Summary of findings and similarities and differences between PA and smoking. Identity and behavior are related through positive relations with behavioral determinants like intention, commitment, confidence or attitudes towards the behavior. The specific determinants through which identity is related differ between PA and smoking. While several PA studies underscore the significance of possible future selves in shaping the connection between identity and behavior, this aspect remains underexplored in the context of smoking. Similarities and differences between PA and smoking are summarized in Table 5.

3.3 PA- and smoking-related identity processes

Identity formation. There would be no relation between identity and behavior without identity formation. All studies on PA underscore the importance of developing an identity which reflects engagement in PA. Formation of such an identity can vary in duration, ranging from a few weeks to six months [55]. Formation seems to involve phases: self-acknowledgment and acceptance before full adoption and expression to others [55,80,81,101,105]. Jin & Roumell [80] propose that once adopted, individuals reach a so-called 'plateau-stage' in which they experience a stable and harmonious sense of identity. PA-related identity can evolve from being extrinsically motivated such as accountability to a doctor, to being intrinsically enjoyable and/or self-relevant [55]. PA-related identity can strengthen over time [56], and studies indicate that it can form in previously inactive individuals and at older ages [55–57,70,80,82,100,105].

Studies on smoking consistently underscore the importance of adopting an identity reflecting non-engagement in smoking. To illustrate, studies demonstrate that identifying as 'nonsmoker,' 'former smoker,' or 'ex-smoker' precedes successful quit attempts and smoking abstinence, even among heavy smokers [89,90,94,95,104]. While duration for developing this new identity is unspecified, results suggest it takes time and effort [89,93,95]. One study proposes that forming an nonsmoker identity may take longer in individuals with a longer smoking history [94]. Additionally, identity formation was observed at both individual and interpersonal levels, with indications that it can also occur at older ages [89,90,94,95,104].

Table 5. Similarities and differences in the relationship between identity and behavior and identity processes for physical activity and smoking in adults aged 45 and over

Characteristics	Similarities between physical activity and smoking	Differences between physical activity and smoking	Unclear
Direct relationship between physical activity- and smoking-related identity and behavior	<ul style="list-style-type: none"> • Direct relationship between identity and behavior, both for individual- and interpersonal-level identity. • Identity was a strong predictor of behavior and predicted behavior over and above other relevant predictors (e.g., self-efficacy, perceived capability to change behavior). • The relationship between identity and behavior seems to endure over time. 	<ul style="list-style-type: none"> • While all studies on smoking found a significant direct relation between identity and behavior, a singular study in the context of physical activity did not observe such a relation. • For physical activity, identity labels reflected various physical activity types, intensities, durations and frequencies. For smoking, identity labels primarily reflected the binary distinction of smoking vs. Non-smoking, and this only for two types of smoking (tobacco, e-cigarettes). • Physical activity-related identity appeared as the strongest predictor of physical activity, while smoking-related identity appeared as second strongest predictor of smoking behavior. • There is a direct relationship between future possible identities and current behavior as well as between physical activity behavior and current identity for physical activity, but findings are lacking for smoking. 	<ul style="list-style-type: none"> • The relationship between physical activity- identity and behavior in the context of smoking. • Whether individual- or interpersonal-level identity is more strongly associated with physical activity and/or smoking behavior, or whether they are equally strongly associated with behavior. • Whether there is a relationship between physical activity-related identity and smoking behavior and/or between smoking-related identity and physical activity-behavior.
Indirect relationship between physical activity- and smoking-related identity and behavior	<ul style="list-style-type: none"> • Identity is indirectly related to behavior through a positive association with behavioral determinants (e.g., intention, commitment, confidence, attitudes towards the behavior). 	<ul style="list-style-type: none"> • Different behavioral determinants in the indirect relationship between identity and behavior. • The important role of possible future selves in the relationship between identity and behavior is discussed in multiple physical activity studies, while it is not in studies in the context of smoking. 	<ul style="list-style-type: none"> • The role of possible future selves in the relation between smoking-related identity and behavior.

Table 5. Similarities and differences in the relationship between identity and behavior and identity processes for physical activity and smoking in adults aged 45 and over (continued)

Characteristics	
Physical activity- and smoking-related identity processes	<ul style="list-style-type: none"> • Identity formation takes time and effort but is possible regardless of prior levels of behavior, and can occur later in life, at both individual and interpersonal levels. • To facilitate engagement in behavior, identity needs to be of the same polarity, i.e., an identity which indicates physical activity, aligned with engagement in physical activity, and an identity which indicates not smoking, aligned with non-engagement in smoking. • Identity formation and maintenance may be facilitated and hindered by a range of factors, some of which are common to both behaviors (e.g., facilitators: valuing benefits from the behavior, social support; barriers: changing out of altruism, conflict with another identity): <ul style="list-style-type: none"> • All factors facilitating/hindering the formation of an identity were also found to facilitate/hinder the maintenance of said identity. However, additional facilitators and barriers were reported for identity maintenance. • Once formed, identity can be maintained over time and oftentimes even consolidated. • Identity-behavior discrepancy is often paired with distress and the implementation of strategies to alleviate it.
	<ul style="list-style-type: none"> • Physical activity-related identity formation seems to follow a phased approach, whereas a phased approach is not explicitly mentioned in the formation of a smoking-related identity. • For physical activity, identity formation was found to take anywhere between a few weeks to six months but for smoking, the amount of time was unspecified. • Factors facilitating and hindering the formation and maintenance of identity. <ul style="list-style-type: none"> • For physical activity, it is desirable to form and maintain an identity which reflects engagement in the behavior while for smoking, it is desirable to form and maintain an identity which reflects non-engagement in the behavior. • Causes for identity change differ between physical activity and smoking. • For physical activity, identity conflict oftentimes happens with an identity unrelated to physical activity whereas for smoking, identity conflict most often pertains to smoker vs. Nonsmoker identity.
	<ul style="list-style-type: none"> • Whether formation of a smoking-related identity follows a phased approach. <ul style="list-style-type: none"> • How long it takes for a smoking-related identity to form. • Whether the difference in facilitators and barriers to identity formation and maintenance is primarily attributable to natural differences between physical activity and smoking, or from differences in study methodologies. • Whether gender and cultural identities do conflict with smoking-related identity. <ul style="list-style-type: none"> • Whether an individual-level smoking-related identity can exist independently of an interpersonal-level smoking-related identity. • The content of smoking-related possible future selves.

Table 5. Similarities and differences in the relationship between identity and behavior and identity processes for physical activity and smoking in adults aged 45 and over (*continued*)

Characteristics	
Physical activity- and smoking-related identity processes	<ul style="list-style-type: none"> • Once formed, identity can be maintained over time and oftentimes even consolidated. • Identity-behavior discrepancy is often paired with distress and the implementation of strategies to alleviate it. • Identity is prone to change, even at older age. • Common factors instigating identity change are health motives and the influence of societal norms. • Feelings of identity loss have been found to be common following identity and behavior change. Many experiencing identity loss will employ strategies to regain (parts of) the lost identity. • The most salient identity (e.g., not a sporty person) typically determines behavior (e.g., avoid gyms). • Identities specific to an older generation with specific generational norms and standards were found to sometimes conflict with physical activity- and smoking-related identity.
Relationship of physical activity- and smoking-related identity with personal, physical activity-related and smoking-related characteristics	<ul style="list-style-type: none"> • Personal-, social- and behavior-related characteristics were associated with identity. Specifically, being female, older and having engaged in the behavior for a greater number of years were positively associated with stronger physical activity- and smoking-related identity. • Other personal characteristics as well as behavior-specific characteristics which relate to identity differed between physical activity and smoking. • Whether physical activity-related characteristics are associated with smoking-related identity, and/or smoking-related characteristics with physical activity-related identity.

Suggested facilitators and barriers of identity formation. Suggested facilitators and barriers to identity formation for PA and smoking can be found in Supplement 4. Studies on PA reported a multitude of factors co-occurring with the formation of a PA-related identity. Some may be considered facilitators of identity formation, and some barriers. To name a few, formation of a PA-related identity appears to be initiated and facilitated by engagement in PA [55–57,70,80,82,100,105], noticing positive outcomes when engaging in PA [55,57,80] or a sense of belonging to and social interactions with a physically active social group [55,82,99,105].

Factors which were suggested to hinder the formation of a PA-related identity included engaging in PA solely out of accountability (e.g., towards a doctor) [55], physical restrictions (e.g., reduced mobility) [80,85,98], and discomfort due to perceptions that one's body and physical capacities do not match that of someone with a PA-identity [57,80,98].

Numerous factors were identified as helpful to the formation of a nonsmoker identity. These factors included abstinence from smoking [89,90,93–95,104], the redefinition of smoking from something relaxing and pleasurable to something undesirable, unwise, or costly, and a family who does not nag to quit smoking [89]. No study reported factors facilitating the formation of a smoker identity.

The primary suggested barrier to the formation of an identity indicating non-engagement in tobacco smoking is (residual) identification with smoking [89,90,93,95,103]. Other potential barriers included smoking cessation as an act of altruism rather than being something coming from the person, [94] and a lack of seriousness about quitting [104]. In the study on e-cigarettes, Farrimond [96] reported viewing e-cigarettes as a practical means to quit or being ambivalent towards e-cigarettes to thwart the formation of a non-vaping identity.

Identity maintenance and consolidation. Once formed, individuals often process information to confirm and consolidate their new identity, a process called assimilation by Jin & Roumell [80]. Longitudinal studies suggest that PA-related identity persists over time and can be maintained [58] and consolidated [56,78] through engagement in PA. Nevertheless, individuals could experience satisfaction or distress with their (new) PA-identity, often due to discrepancies between PA-behaviors and identity [80]. Satisfaction or distress may depend on personal factors such as personal PA history, inclination towards PA, public self-consciousness or experience with aging. Coping with distress from identity-behavior discrepancy involved behaving in a way that matched the PA-related identity, or adjusting the identity itself [55,57,80,100]. For long-term active individuals, PA became an integral part of their self, or a way to express their authentic self [70,85,98,101], contributing to the maintenance of PA and their PA-related identity.

Even after resuming smoking and thereby reclaiming their smoker identity, many individuals still identify as nonsmoker [95]. This suggests that a nonsmoker identity is usually maintained, although the authors propose that this may be for social desirability reasons rather than one actually embracing the identity. In former smokers, any degree of maintained identification with smoking was paired with distress and a higher likelihood of relapse [93], feeling vulnerable to relapse [94] and actual relapse [90]. This held true even after adjusting for age, gender, SEP, ethnicity, country of origin, smoking history, quit duration, survey mode (completed over the phone or online), and year of recruitment (any of the 9 years from this longitudinal study) [90]. Identification with smoking gradually decreases with longer abstinence [90,94,95], and urges became easier to overcome once a 'nonsmoker' or 'ex-smoker' identity was established [89,93,95]. An identity as nonsmoker/ex-smoker can also serve to confirm higher-order identities (e.g., 'good parent', 'healthy person') which are not necessarily directly linked to smoking [104]. While some individuals may still feel drawn to smoking after years of abstinence [90], adopting a nonsmoker identity may help reduce feeling vulnerable to relapse [94].

Suggested facilitators and barriers of identity maintenance. Suggested facilitators and barriers to identity formation for PA and smoking can be found in Supplement 4. Various factors may facilitate the maintenance of the developed identity. For PA, most factors found to contribute to the formation of a PA-related identity also applied to the maintenance of said identity, except the factors of Self-Determination Theory named in Springer et al. [101]. Interestingly, expressing a PA-related identity to others seems more important for PA maintenance than for PA formation [56]. Furthermore, being physically active enhances perceived ability to engage in PA and continued efforts to stay active, aiding in maintaining the new PA-related identity [106].

Similarly, factors suggested to hinder identity formation also impeded identity maintenance. Studies on patient groups suggested unique barriers to maintaining a PA-related identity, such as concerns about worsening symptoms and decreased PA self-efficacy due to physical limitations [77,88].

Former smokers employ various strategies to maintain and consolidate their new abstinent status and identity, such as coping with cravings [89,95], reaffirming the new nonsmoker identity, pride at being a nonsmoker and greater regard for nonsmokers [93]. Certain factors aiding identity formation such as commitment and ownership of the decision to quit appeared to also help maintain and consolidate a nonsmoker identity [89].

The study on e-cigarettes [96] is the only study to have suggested a factor assisting the maintenance of a vaping identity, which is to view e-cigarettes as enjoyable.

Identity change. Maintaining consistent identity levels is not always achieved, leading to potential identity changes [80]. To illustrate, PA-related identity was found to be fluid, sometimes even vulnerable and unstable, and to vary in strength naturally [58], following life events (e.g., moving, disease, divorce) or life experiences (e.g., taking up a hobby, health reasons, experiences of aging, feeling more vulnerable to injury following a fall) [57,70,80,98]. Societal norms, e.g., concerning health and fitness [57], can also prompt identity shifts at older age. [70,71,80]. Identity changes are often gradual and not sudden [98]. PA-related identity change can happen to anyone, regardless of the initial strength of PA-related identity. To illustrate, Leavy and Åberg [82] documented that retirees who were physically active during employment could experience a shift in PA relevance and therefore identity post-retirement. Similarly, Rhodes et al. [69] noted strengthened PA-related identity in individuals having maintained pre-pandemic PA-levels and those with strong PA intentions, while weakening was observed in previously active individuals having reduced activity post-pandemic and with weaker PA intentions. This held true after controlling for age, gender, employment status, and education.

Former smokers were found to undergo a gradual individual-level identity transition from 'smoker' to 'nonsmoker' or 'ex-smoker' after quitting smoking [89,95] and an interpersonal-level identity transition from 'smoker' to 'nonsmoker' [95]. Redefining oneself as a 'nonsmoker' was reported important for successful smoking cessation efforts [92,95,103]. For certain former smokers quitting through a group program [95], shift in smoking-related social identity was enhanced by the support of friends and family, and by attachment to fellow program participants. Following this transition, newly quit smokers perceived smokers as an unwelcome out-group, and nonsmokers as the new superior in-group [95]. Smith [104] suggested that a change in smoking-related identity indicated 'being serious' about living smoke-free. For certain older individuals, redefining their smoking-related identity was prompted by health warnings associated with smoking not prevalent during their initial smoking years [89]. For others, factors like increased cigarette price, social disapproval of smoking [89] contributed to reshaping their identity post-cessation [89,95].

Identity loss. Individuals may feel like having lost part of themselves (identity loss), following changes in behavior and identity. Kullman et al. [81] found that disbandment of a running group due to COVID-19 restrictions resulted in identity loss among its members. To cope and regain part of their lost identity, individuals engaged in new behaviors like virtual contact with members of the running group, or solo running to strengthen their running self-identity in the absence of possibilities to strengthen their runner group identity. Similar feelings of identity loss occurred following forced changes from life events [57,98], injury or disease [77,88].

Studies on smoking indicated that quitting smoking was often paired with identity loss [89,93,95,103]. (Re)lapse was sometimes seen as a way to reclaim the lost smoker self-identity [93].

Identity salience and conflicting identities. PA-related identity facilitates PA participation, yet other identities may override it, impede its formation or maintenance, hindering engagement. For example, a salient identity as ‘not a group person’ may lead to avoiding parks and gyms, limiting PA involvement [82]. Similarly, a salient identity as an ‘unsuccessful sportsperson’ can create discomfort when engaging in sports [57]. Pentecost and Tacket [87] found conflicts between African/Caribbean identities associated with larger body sizes, and PA-related identities, often synonym with smaller body sizes. Gender roles can also conflict with PA-related identities and behaviors, especially for women with nurturing identities and a strong sense of duty to their families [82,87,99]. Furthermore, many older individuals perceive a conflict between holding a PA-related identity and old age, which they associated with diminished physical capital, health and agility [71,82,87,98,105]. Last but not least, Leavy and Åberg [82] suggest that PA-identity may be situational, such as in the workplace, and that retirees sometimes no longer identify with PA post-retirement.

Studies on smoking emphasized that during urges to smoke, an identity as a nonsmoker or ex-smoker must take precedence over any lingering identity as a smoker to prevent (re) lapses [89,90,93–95]. The most common identity conflict seems to be between smoker and nonsmoker/ex-smoker identities [89,95]. Additionally, smoking-related identity may conflict with role identities, like being a good friend or being someone who fits with new vs. old generational norms and standards [89].

Independence of individual- and interpersonal level identity. Rossing et al. [57] suggest the existence of an independent exercise self-identity, separate from an exerciser social identity. For example, following the choice to engage in PA in a self-chosen, self-relevant way rather than trying to match societal standards of being an ‘exerciser’. Conversely, individuals may adopt a social PA-related identity without a corresponding self-identity [71]. This phenomenon may relate to the communal nature of interpersonal level identities, where group norms and goals prevail over individual preferences and identities [81].

In the context of smoking, findings imply that individuals lacking identification with other e-cigarette users (i.e., vaping-related interpersonal-level identity) are unlikely to acknowledge a vaping self-identity [96]. However, this proposed interdependence between smoking-related social- and self-identities is based on a single study, lacking conclusive evidence for broader application.

Content of possible future identities. The content of PA-related possible future selves, or possible future identities, typically revolved around body image (weight, attractiveness), health and (in)dependence (i.e., related to potential incapacitation or requiring care) [83,84,86,97,99] or physical capacities (i.e., being mobile and healthy) [97]. The content of possible future selves could evolve over time. Whaley and Schrider [97] found that 10 weeks after an exercise program, hoped-for future selves focused on body image and remaining healthy, while feared selves centered on avoiding dependence and negative health consequences. The content of possible future selves varied by exercise level [86]. When listing their hoped for and feared possible future-selves, non-exercisers emphasized body-image while long-term exercisers emphasized physical health. Notably, long-term exercisers were generally more confident than non-exercisers about their possible future self would becoming reality, and found it important and likely that it would [86].

No study on smoking examined possible future selves, therefore it is unknown what the content of smoking-related possible future selves may be.

Summary of findings and similarities and differences between PA and smoking. Formation of a PA- or smoking-related identity is a complex process that demands time and effort, regardless of prior behavior levels, and can occur later in life at both individual and interpersonal levels. To enhance behavior engagement, it is important that identity aligns with behavior of the same polarity, i.e., indicating participation in PA or non-smoking. PA-related identity formation appears phased and to take weeks to months, while for smoking phases and timing of identity formation were unspecified. Factors suggested helpful and unhelpful to identity formation vary between the two behaviors, with some commonalities, and overlap with factors (un)helpful to identity maintenance. Identity generally persists, often even consolidating over time, yet discrepancies with identity may lead to distress and prompt coping strategies. Identity is subject to change, spurred by, for example, health motives or societal norms, which can lead to feelings of identity and subsequent strategies to regain the lost identity. The most salient identity typically determines behavior, potentially conflicting with identities specific to older generations. While individual-level PA-related identity can exist independently of interpersonal-level identity this distinction's existence in smoking remains unclear. The content of possible future selves for PA often revolved around body image and health.

3.4 Relationship of PA- and smoking-related identity with personal, PA-/smoking-related characteristics

Personal characteristics. Studies indicated a relation between PA-related identity and personal characteristics. Exercise self-definitions were significantly more acknowledged by women aged 65+ vs. 50-65, African-American vs. Caucasian women, and women who consider having less vs. more mobility problems [56]. In addition, individuals with lower

BMI and identifying as non-White exhibited stronger exercise identities across genders [78]. Females tended to have a stronger PA-related collective self-esteem – reflecting social PA-identity – than males, and older individuals with stronger collective self-esteem maintained higher PA-levels to a later age than older individuals with lower PA-related collective self-esteem [79]. In contrast, Lin et al. [68] found no gender differences in PA-related group identity.

In studies on smoking, women, older people and individuals with smoking-related health issues [92] exhibited significantly stronger identification with smoking. Notably, women were also found to identify with nonsmoking significantly more than males [92]. Females scoring higher on general anxiety were more likely to report negative emotions about being smokers [103]. Furthermore, Leas et al. [91] identified a subgroup of ‘non-identifying smokers’, comprising individuals who smoke but do not see themselves as smokers, constituting approximately 10% of the smoker population. Non-identifying smokers were more likely to be 65+, male, daily smokers, from ethnic minorities (except Hispanic white) and to not reject identification with addiction.

Social characteristics. Individuals with a stronger PA-related identity tend to express this identity to others [56,73,101] and to promote exercise to others (e.g., spouse, parent) [55]. For individuals contemplating a change in their PA, support from family but not from friends was more important when PA-identity was low than when it was high [102].

For smoking, being around other smokers was found to help rationalize (re)lapses, as it tends to evoke ones retained identity as smoker, and to alleviate feelings of isolation or detachment from other smokers [93]. Conversely, findings by Brown (1996) [89] insinuate that for individuals who currently smoke, being around nonsmokers facilitates quit attempts because it promotes and reinforces an identity as nonsmoker.

PA-related characteristics. One study reported that exercise self-definitions were significantly more acknowledged by women who perform 30+ vs. less than 30 minutes of walking per week [56]. Studies proposed that the longer the PA history, the stronger PA-related identity [54,57,82,85,98], and that the longer a PA-related identity has been held, the greater the engagement in PA-behavior [82,98].

No study on smoking assessed the relationship between PA-related characteristics and smoking-related identity.

Smoking-related characteristics. The more cigarettes [92] and years one smoked [94], and the higher the physical nicotine dependence [103], the more important smoking was to

their sense of self. Furthermore, those with a longer smoking history [94] exhibited a stronger identification with smoking.

No study on smoking assessed the relationship between smoking-related characteristics and PA-related identity.

Summary of findings and similarities and differences between PA and smoking. Identity intertwines with personal, social, and behavior-related characteristics, showing positive associations with being female, older, and having a longer history of engagement bolstering PA and smoking identities. Conflicts with PA-related identity were noted in women and those with an African/Caribbean cultural identity. Disparities in personal and behavior-specific traits related to identity were observed between PA and smoking, warranting further investigation into the association between PA-related characteristics and smoking-related identity, and vice versa. See Table 5 for a summary of similarities and differences between PA and smoking.

DISCUSSION

This review offers a state-of-the-art synthesis of how identity is conceptualized and operationalized in relation to PA and smoking among adults aged 45+ engaging in both behaviors in varying levels. It explores and compares how identity relates to a health-promoting and health-compromising behavior, and integrates the role of personal-, PA-related and smoking-related characteristics play in this relationship.

Findings highlight a clear relationship between identity and behavior in PA and smoking, emphasizing the significance of both individual- and interpersonal-level identity in motivating behavior. Strong identification with PA and physically active peers is positively associated with more frequent, varied and intense PA, consistent with previous findings in younger [11,26,27,107–110] and moderately to vigorously active individuals [27]. For smoking, stronger identification with nonsmoking and nonsmokers is positively associated with smoking cessation and staying abstinent, which also corroborates previous evidence in younger populations [13–15,28,110]. While one reviewed study [67] reported a non-significant association between PA-related identity and behavior, it employed a scale measuring individual and interpersonal identity levels, which may mask independent existence of identity on both levels [57,71]. To mitigate this, we suggest utilizing separate sum scores for individual and interpersonal identity levels to avoid measurement bias.

This review reveals that the identity-behavior relationship, and underlying identity processes are comparable for a health-promoting and health-compromising behavior. However,

discernable differences and remaining uncertainties imply that certain aspects of the relationship and certain identity processes may be unique to each behavior. Future research on identity-behavior dynamics in PA and smoking should address as-of-yet unresolved elements. Nonetheless, the insights gleaned from this review offer valuable guidance for developing effective identity-related interventions to influence PA and smoking.

This review opens multiple interesting avenues for future research. First, the causal relationship between identity and behavior. Two reviewed studies investigated whether the relationship between possible future identities and PA-behavior is mediated by PA-identity [84] or whether possible future identities act as mediator [97]. Contradictory results and the absence of formal testing underscores the need for further investigation. Second, the association between past/future identities and current behavior, as identified in this review, hints at a reciprocal dynamic relationship between identity and behavior. While this aspect was not explicitly explored in the reviewed studies, prior research on smoking among younger individuals demonstrated a reciprocal relationship between smoking-related identity and behavior [13], opening up intriguing avenues for future research. Third, there may be a stronger association of individual-level smoking-related identity with behavior than interpersonal-level identity [13], but this remains to be formally tested.

Certain identity processes may be specific to older adults. For example, older women may encounter obstacles in forming a PA-related identity due to conflicts with altruistic, caring domestic or familial identities [55,82,99], a phenomenon likely more pronounced in generations with more traditional gender roles. Older generations may also have felt pressured to reshape their smoking-related identity amid increased health warnings and stigma surrounding smoking [89]. The health status of older adults appears pivotal in adopting and maintaining a PA-related identity [82,87,98,105], and changes in smoking-related identity [89]. Finally, older adults identify more strongly with PA than with exercise [54,56]. More research is warranted to formally assess potential age and generational differences in identity processes.

Aligned with identity theories [29,111] and prior empirical research (e.g., 14,102), this review illustrates that identity is mutable. For example, individuals strongly identifying as smokers can transition to ex-smoker identity post-cessation, and former smokers can revert to a smoker identity [93–95]. This prompts inquiry into the fate of former identities: do they remain dormant, possibly reactivated by triggers? Do they retreat behind a dominant identity? Or do they vanish entirely? There seems to be limited research on this topic, with the exception of McConnell [112], but it forms another interesting avenue for future research.

This scoping review revealed diverse yet overlapping identity-related terms and measurement tools, a common thread in identity research. To illustrate, already a decade ago, Oyserman and Destin [113] observed the interchangeable use of ‘self-concept’ and ‘identity’ in the literature. Varied terminology and measurement methods may be attributed to different research disciplines (e.g., Sociology, Health Psychology, Public Health). Consequently, fostering interdisciplinary collaborations and involving non-scholars to establish one clear, common, theoretically sound definition and measurement device for (PA-/smoking-related) identity [114], appears advantageous. Categorizing identity-related terms into an individual-level and interpersonal-level identity, as done in this review, may aid consensus building, as may collaborative ontology development [115] (see e.g., Notley et al. [116]). Terms more or less related to identity identified in this review (see Supplement 3) may help refine existing ontologies in the field.

This review pioneers cataloging identity labels related to PA and smoking, uncovering internal negotiations when behavior diverges from identity. Certain labels may feel constraining (‘smoker’), while others indicating intentions for behavior change (‘smoker considering quitting’) or reflecting accomplished change (‘smoker who has chosen to no longer smoke’) may feel more personally self-relevant. Adapting one’s identity to align with behavior (e.g., 2,109) and aligning behavior with identity are coping strategies proposed by identity theories to reduce identity-behavior dissonance. Stimulating the ‘right’ identity may be key to promoting corresponding behavior, helping to overcome identity conflict and resolve ambivalence [105].

Possible future selves interventions are more prevalent in research on PA than on smoking. Results indicate their effectiveness in changing PA-behaviors [118–121]. Exploration of such interventions for smoking cessation is relatively recent [11,26,27,107]; only a few studies have applied them with varying success [15,122–124]. Insights from our ongoing parallel review on identity interventions may elucidate reasons for this discrepancy. Nonetheless, considering the parallels in the role of identity in PA and smoking, we anticipate possible future selves interventions to also show promise for smoking cessation and encourage more research.

Prior studies show a significant relationship between smoking and PA-behaviors [125,126], a positive synergy between PA-uptake and intention to quit smoking [24], and a significant relationship between smoking- and PA-related identities [110]. This highlights the potential of multi-behavior/multi-identity interventions, previously touted as the ‘future of preventive medicine’ [127]. While some studies have explored this approach and tested interventions addressing both smoking and PA simultaneously [128], to our knowledge, only two have considered PA- and smoking-related identity and behavior [110,129]. Both studies observed a reduction in smoking following increased PA, underscoring the potential of interventions targeting both behavior and identity for PA and smoking. One potential reason for the observed reduction in smoking in these studies is the activation of a higher-order identity like ‘healthy person’, which may conflict with the smoker identity. Therefore, in addition to testing the effectiveness of a multi-behavior/multi-identity approach, future interventions could investigate whether reinforcing a higher-order identity (e.g., ‘healthy person’) can induce changes in multiple health behaviors.

Strengths and limitations

This scoping review offers a comprehensive synthesis and comparison of identity’s conceptualization, operationalization and role in both smoking and PA. Its strengths reside in adhering to several methodological frameworks for scoping reviews [39,40,130], utilizing two artificial intelligence technologies for study selection, and incorporating input from 14 experts to synthesize evidence spanning 30 years. In addition, it focuses on two different health behaviors and includes research originating from numerous research disciplines.

There are however limitations to consider. First, while focused on middle-aged to older adults, including younger populations could enhance generalizability. However, despite potential age-specific identity processes, similarities between age groups are anticipated. Second, while the included studies spanned various research disciplines, our research team solely comprised individuals from the field of Health Psychology, potentially leading to a biased interpretation of the findings. Nevertheless, we sought to mitigate this limitation by incorporating input from experts in various disciplines within Psychology and Behavioral Science. Third, quality assessment of included studies may have enhanced findings, though challenges exist in selecting reliable tools for this purpose [131]. The detailed summaries of identity conceptualization and operationalization serve as an initial step toward quality assessment in this respect.

CONCLUSION

This review pioneers in the synthesis and comparison of identity's terminology, labels, measurement and role in relation to (quitting) smoking and physical (in)activity, among adults aged 45+. It reveals a complex enduring relationship between identity and behavior in both PA and smoking along with numerous identity processes encompassing identity formation, - maintenance, - change and - loss. Despite variations, the relationship between identity and behavior and underlying identity processes may not differ fundamentally between health-promoting and health-compromising behaviors. Diverse identity terms and measurement tools exist, yet there is overlap in defining and measuring PA- and smoking-related identities. Establishing a unified definition and measurement tool for PA- and smoking-related identity on individual and interpersonal levels is recommended. Personal, social, PA-related and smoking-related characteristics play a part in the relationship between identity and behavior, albeit differently for PA and smoking. Future research avenues include investigating causality in the identity-behavior relationship, the fate of replaced identities, unresolved points from this review, and age group differences. The takeaway from this review is that endorsing identities associated with smoking abstinence and PA increases the likelihood of being physically active and quitting smoking.

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Supplement 1 - Screening manual for full-text screening (performed in Excel)

Variable	Explanation
A REFERENCE	Reference / title / author / DOI of record
ELIGIBILITY	
B COMPLETENESS	<p>There is a full-text available.</p> <p><i>Note. If no full-text is accessible online, we will proceed as follows:</i></p> <ol style="list-style-type: none"> 1. The corresponding author of the record will be contacted to obtain a copy of the full record. 2. In case of no reply, one reminder will be sent to obtain the full record and be excluded if it remains unavailable to this review team. 3. In case contact details of the corresponding author are outdated or unavailable, we will reach out to one other author of the record. In case of no reply, one reminder will be sent to the author obtain the full record and be excluded if it remains unavailable to this review team.
C LANGUAGE	<p>The full-text is written in a language spoken by the authors conducting the review (i.e., English, Dutch, French or German) or in any language for which translation is available via translation tools.</p> <p><i>Note. Full-texts written in any other language than English, Dutch, French or German will be assessed against below eligibility based on the translation from translation tools. In case the translation is not deemed of sufficient quality to continue the screening process, the full-text will be excluded.</i></p>
D PEER-REVIEWED	<p>The full-text belongs to a peer-reviewed scientific publication.</p> <p><i>Notes. An exception is made for conference abstracts for which we will proceed as follows:</i></p> <ol style="list-style-type: none"> 1. Search for associated peer-reviewed published full-text online 2. If full-text is available online, verify whether full-text is part of our dataset 3. If full-text is part of our dataset → remove/exclude abstract 4. If full-text is not part of our dataset → remove/exclude abstract, add full-text to our sample and screen full-text 5. If no full-text available, contact authors following the procedure in B. <p><i>Exclude dissertations and book (reviews). For commentaries, include when the commentary is about an eligible scientifically peer-reviewed article. If so, chart commentary together with article.</i></p>
E AGE	The record includes individuals aged 12 and over or the mean age of the sample is 12 years or higher.
F BEHAVIOR	
SMOKING	<p>The record focuses on (direct precursors of) (non)smoking behaviors ...</p> <p><i>Note.</i></p> <p><i>Smoking behavior in this review refers to the act of smoking tobacco (any type) or electronic cigarettes. Smoking behaviors may encompass behaviors related to smoking initiation, maintenance and/or cessation.</i></p>
AND/OR PHYSICAL ACTIVITY	<p>... and/or on (direct precursors of) recreational, non-professional physical activity behaviors - performed by the study participant(s) individually or together with a team they are part of - or on physical inactivity.</p> <p><i>Notes.</i></p> <p><i>Physical activity behavior in this review refers to 'bodily movements produced by skeletal muscles that require energy expenditure' (WHO, 2018).</i></p> <p><i>Records will be excluded when participants are structurally compensated to engage in physical activity or sports. Records will also be excluded when it is apparent that physical activity is performed in excess (e.g., as a result of an addiction to physical activity).</i></p>

Variable	Explanation
G SUBJECT	
IDENTITY	The record studies smoking-related and/or physical activity-related self- or group- identity ...
INTERVENTIONS	<p>Notes.</p> <p><i>Self-identity in this review refers to perceptions or views that people have of themselves.</i></p> <p><i>Group identity in this review refers to perceptions or views that people derive from their membership to social groups.</i></p> <p><i>In this review, self- or group-identity may encompass formation, maintenance and/or change.</i></p> <p><i>The following concepts are known to differ from the definition of identity used in this review based on scientific definitions (see Supplement 2). Records focusing on one or more of these concepts will be considered as irrelevant and be excluded: self-esteem (but not collective self-esteem), self-efficacy, self-confidence, body image, body schema, self-compassion, body cathexis, perceived physical fitness, body (dis)satisfaction, self-acceptance, body representation, self-consciousness, subjective social status, self-forgiveness, group cohesion, physical self-presentation confidence, social identity, physical self-concept (when meant as self-concepts about the physical/tangible self), global self-concept, self-construal.</i></p> <p><i>... and/or the record studies intervention (aiming to influence smoking and/or physical activity behaviors and/or identities.</i></p>
H AIM	Full-text focuses on aim one or aim two of the final review.
I EXCLUSION	<p>The record gets excluded when:</p> <p>la – it does not relate to own smoking/physical activity or that of a group/ team the study participant is part of (e.g., physical activity performed by a sport team the participant is a fan of, studying the identity of sport psychologists).</p> <p>lb – a relation between smoking- and/or physical activity-related identity on one hand, and smoking and/or physical activity on the other hand is studied, but the relation is not a direct, mediation or moderation relation.</p> <p>lc – polysubstance is studied, and it is not possible to identify which findings pertain specifically to smoking.</p> <p>ld – the record aims to validate identity-related questionnaires/ methodologies/theories/models without investigating the direct relation between the questionnaire/methodologies/theories/models and smoking/physical activity behaviors.</p> <p><i>Note. See the table below for an overview of questionnaires which are known to fall within or outside the scope of the review.</i></p> <p>le – It focuses on aim one of the final review and participants aged 45 years and older are not the primary focus of the study or not specifically considered in sub-group analyses.</p>
J INCL-EXCL	Decision for inclusion or exclusion
K NOTES	Notes / remarks
L LINK	Optional: Full-text link

Below table illustrates the screening decision whenever the listed questionnaire were employed to measure a self-concept related construct or being validated. This is a non-exhaustive list. The eligibility of questionnaires not listed in the table below were assessed on a case-by-case basis.

Exclude	Include
Rosenberg self-esteem scale (Rosenberg, 1965) does not have subscales (measures global self-esteem (Huang & Dong, 2012)	Athletic identity measurement scale (AIMS) (Brewer, Van Raalte, & Linder, 1993)
Body-esteem scale (BSE, Mendelson, Mendelson & White, 2001) – subscales: Body Esteem Appearance, Body Esteem Weight, and Body Esteem Attribution (i.e., evaluations attributed to others about one's body/appearance)	Measures athletic identity (the extent to which one identifies as an athlete) which we decided to exclude in the definition table. Include when it refers to an individual identifying with being a non-professional athlete. Otherwise exclude.
Multidimensional self-esteem test – subscales: Interpersonal relationships, environmental control competence, emotionality, schooling achievement, family life, bodily experience, global self-esteem, Tremolada et al., 2017)	Academic and Athletic Identity Scale (AAIS) (Yukhymenko–Lescroart, 2014)
(Children's) perceived (physical) competence scale (Harter, 1982) – subscales: cognitive competence, social competence, physical competence	Measures academic and athletic identity. Same comment as above.
Heatherton and Polivy State Self-esteem Scale (Heatherton & Polivy, 1991) – subscales: performance self-esteem, social self-esteem, appearance self-esteem)	Tennessee self-concept scale (TSCS) (subscales for 'internal' are identity, self-satisfaction and behavior. Subscales for 'external' are physical self, moral ethical-self, personal self, family self and social self) → INCLUDE if internal scale (identity) is measured
Body Cathexis Scale (BCS) factors: subordinate and independent body features; physical health and fitness; sexual; face and overall appearance; weight; physique/strength; health and effectiveness (Hammond & Rourke, 1983)	Tennessee scale of self-image Subscales: negative self-concept (self-criticism) Positive self-concept (physical self, moral-ethical self, personality self, family self, social self, identity, self-image, behaviour, self-evaluation) (Faganel & Tušak, 2005) → INCLUDE if identity scale relates to smoking and/or physical activity
Baller Identity Measurement Scale (Harrison et al., 2010) (subscales: social identity, exclusivity, positive- and negative affectivity) Measures identification with being a 'baller' which is used to refer to profiles recruited for revenue sports. Although it does include relevant items 'I consider myself a baller', 'Balling is the most important part of my life',	
Harter Self-perception Profile for Children (Granleese et al., 1994) – subscales: Scholastic competence, Social acceptability, Athletic competence, Physical appearance, Behavioral conduct, Global self-worth)	
Social physique anxiety scale considering we exclude articles on physique anxiety (see definition table)	
Richard's physical self-concept scale (1987) – subscales: body build, action, appearance, health, physical ability, strength and satisfaction)	
Pictorial scale of physical self-concept (Estevan et al., 2019) – Subscales: Sportiness, Flexibility, Endurance, Speed, Strength, Coordination, Appearance, Enjoyment)	
Situational Motivation Scale (SIMS) – Subscales: Intrinsic motivation, Identified motivation, External regulation and Amotivation)	
Piers-Harris Self-concept scale – subscales: behavior, intellectual and school status, physical appearance and attributes, anxiety, popularity, happiness and satisfaction) (Piers & Harzberg, 2002)	
Self-perception profile – subscales: bodily attractiveness, sports competence, physical strength, physical conditioning, general physical self-worth)	

Exclude	Include
Children and Youth Physical Self Perception Profile (CY-PSPP; Eklund, Whitehead, & Welk, 1997) – subscales: sport/athletic competence, attractive body adequacy, strength competence, condition/stamina competence, global physical self-worth and global self-worth)	
Physical Self-Concept questionnaire – subscales: ability, condition, attractiveness and strength)	
(Physical) self-description questionnaire (designed to measure 11 scales: Strength, Body Fat, Activity, Endurance/Fitness, Sports Competence, Coordination, Health, Appearance, Flexibility, Global Physical Self-concept, and Global Esteem) (Marsch, 1995) (Marsh & O’Niell, 1984)	
Fox (1998): ‘PSDQ provides a comprehensive assessment of self-perceptions covering a wide range of subdomains of the physical self (p. 306)’.	
Self-concept form-5 (AF-5) – subscales: academic self-concept, social self-concept, emotional self-concept, family self-concept, physical self-concept (Valero et al., 2020)	
Self-concept clinical inventory (SCCI) – subscales: social acceptance/rejection, self-efficacy, psychological maturity, impulsiveness (Pombo et al., 2016)	
Physical self-perception profile (PSPP) (Fox & Corbin, 1989) – subscales: Sport, Condition, Body, Strength, Physical self-worth	
Physical self-efficacy scale – subscales: Perceived Physical Ability, Physical Self-Presentation Confidence (Ryckman et al., 1982)	
Physical self-inventory – subscales: general self-esteem, physical self-worth, sport competence, physical condition, attractive body, physical strength (Ninot et al., 2001)	
Multidimensional Self Concept Scale (MSCS) (Bracken, 1992) – subscales: social, competence, affect, academic, family, and physical self-concept (Rotatori, 1994)	

Supplement 2 – List of included and excluded terminology

The following table illustrates our decision to include or exclude studied constructs identified in retrieved records based on whether their definition aligned with our definition of identity. Constructs are presented in alphabetical order and sources for definitions are presented.

	Include / Exclude	Reason
Athletic identity	Exclude	"Defined as the degree to which an individual identifies with the athlete role, within the framework of a multidimensional self-concept." (Brewer et al., 1993).
Behavior change strategies / techniques	Exclude when BCT is clearly not related to identity	In BCT taxonomy (BCTTv1, Michie et al., 2015) some of the BCTs (i.e., technique 13.1 – 13.5) are identity-related.
Body (dis)satisfaction	Exclude	"Body satisfaction, a separate construct from body image, denotes an investment in and concern with appearance." (Risica et al., 2008)
Body cathexis	Exclude	"Body cathexis is defined as the degree of satisfaction reported by an individual for the parts of his body." (Jourard & Secord, 1955).
Body image	Exclude	Definition APA: "The mental picture one forms of one's body as a whole, including its physical characteristics (body percept) and one's attitudes toward these characteristics (body concept). Also called body identity." Definition from Longo (2016): "a conscious image of the size, shape, and physical composition of our bodies."
Body representation	Exclude	Definition Wen et al. (2016): "Body representation refers to perception, memory, and cognition related to the body and is updated continuously by sensory input" (Wen et al., 2016)
Body schema	Exclude	APA definition: "The cognitive organization of one's appearance, including internal image, thoughts, and feelings". Definition Longo (2016): "A dynamic model of the body posture underlying skilled action. The body schema is thought to be less accessible to conscious introspection".
Collective self-esteem	Include	"Individual's self-evaluation as a member of social groups" (Bailis et al., 2008) APA definition: "Individuals' subjective assessment of that portion of their self-concept that is based on their membership in social groups, such as families, teams, or schools, as well as on categories that have psychological significance for them, such as race, ethnicity, or nationality. Collective self-esteem is often measured using the Collective Self-Esteem Scale (CSES), developed in 1992 by U.S. social psychologists Riia K. Luhtanen and Jennifer Crocker. Respondents evaluate their general group memberships across four subscales pertaining to membership esteem (evaluation of their worthiness as members of a group), private collective self-esteem (evaluation of the worthiness of the group), public collective self-esteem (evaluation of others' perceptions of the group), and the importance of the group to their identity."
Perceived physical fitness	Exclude	"Perceived parameters of health, cardiovascular fitness (CVF) capabilities as measured by oxygen consumption (VO2), body composition (BC), dietary intake, and physical activity." (Wells et al., 2016)
Self-acceptance	Exclude	APA dictionary: "Relatively objective sense or recognition of one's abilities and achievements, together with acknowledgment and acceptance of one's limitations. Self-acceptance is often viewed as a major component of mental health."

	Include / Exclude	Reason
Self-compassion	Exclude	APA dictionary: "A construct derived from Buddhist thought and entailing a noncritical stance toward one's inadequacies and failures. It has been suggested that if self-criticism can lead to negative emotions, self-compassion may promote well-being by protecting one from the negative emotional implications of one's perceived failings".
Self-concept	Include	APA dictionary: "Self-concept refers to description and evaluation of oneself, including psychological and physical characteristics, qualities, skills, roles and so forth. Self-concepts contribute to the individual's sense of identity over time."
Self-concordance	Include	"The extent to which people pursue personal goals with feelings of intrinsic interest and identity congruence." (Sheldon et al., 2001)
Self-confidence	Exclude	Merriam Webster dictionary: "Self-confidence refers to confidence in oneself and in one's powers and abilities."
Self-consciousness	Exclude	APA dictionary: "A personality trait associated with the tendency to reflect on or think about oneself. Psychological use of the term (e.g., in personality measures) refers to individual differences in self-reflection, not to embarrassment or awkwardness. Some researchers have distinguished between two varieties of self-consciousness: (a) <u>private self-consciousness</u> , or the degree to which people think about private, internal aspects of themselves (e.g., their thoughts, motives, and feelings) that are not directly open to observation by others; and (b) <u>public self-consciousness</u> , or the degree to which people think about public, external aspects of themselves (e.g., their physical appearance, mannerisms, and overt behavior) that can be observed by others."
Self-definition	Include	APA dictionary: "A self-view, self-concept, or other belief about the self."
Self-efficacy	Exclude	Self-efficacy refers to an individual's belief in his or her capacity to execute behaviors necessary to produce specific performance attainments (Based on Bandura, 1977, 1986, 1997).
Self-esteem	Exclude	Merriam Webster dictionary: "Self-esteem is a confidence and satisfaction in oneself."
Self-forgiveness	Exclude	"Self-forgiveness occurs over time and is a deliberate, volitional process initiated in response to one's own negative feelings in the context of a personally acknowledged self-instigated wrong, that results in ready accountability for said wrong and a fundamental, constructive shift in one's relationship to, reconciliation with, and acceptance of the self through human connectedness and commitment to change." (Webb et al., 2017).
Self-image	Include	APA dictionary: "One's view or concept of oneself. Self-image is a crucial aspect of an individual's personality that can determine the success of relationships and a sense of general well-being. A negative self-image is often a cause of dysfunctions and of self-abusive, self-defeating, or self-destructive behavior."
Self-perception	Include	Merriam Webster dictionary: "Self-perception refers to the idea that you have about the kind of person you are."
Self-presentation	Include	APA dictionary: "Any behaviors intended to convey a particular image of, or particular information about, the self to other people. Self-presentational motives explain why an individual's behavior often changes as soon as anyone else is thought to be present or watching."
Self-schema	Include	APA dictionary: "Cognitive framework comprising organized information and beliefs about the self that guides a person's perception of the world, influencing what information draws the individual's attention as well as how that information is evaluated and retained."

	Include / Exclude	Reason
Self-stigmatization	Include	"Self-stigmatization has been defined as the process in which a person (with a mental health diagnosis) becomes aware of public stigma, agrees with those stereotypes, and internalizes them by applying them to the self." (Corrigan, Larson, & Kuwabara, 2010).
Self-worth (not the subscale of physical self-concept)	Exclude	APA dictionary: "An individual's evaluation of himself or herself as a valuable, capable human being deserving of respect and consideration. Positive feelings of self-worth tend to be associated with a high degree of self-acceptance and self-esteem".
Social physique anxiety	Exclude	APA Dictionary: "Social physique anxiety refers to apprehension and fear related to concerns about how others will perceive one's physical appearance."
Sport identity	Include	"The formation of an individual's self-identity as a "sporty person"." (Lau et al., 2007)
Subjective social status	Exclude	"Subjective social status is defined as one's perception of their social class relative to others." (Diemer et al., 2013).

Supplement 3 – Search strings for individual databases

PubMed (<http://www.ncbi.nlm.nih.gov/pubmed?otool=leiden>)

Excl. Book chapters, dissertations and commentaries

("Identification, Psychological"[majr] OR "Social Identification"[majr] OR "identity"[ti] OR "Self Concept"[majr:noexp] OR "Self Concept"[ti] OR "self perception*"[ti] OR "self image*"[ti] OR "self view*"[ti] OR "sense of self"[ti] OR "sense of identity"[ti] OR "sense of identities"[ti] OR "Social Identification"[majr] OR "Social Identification"[ti] OR "self identity"[ti] OR "self identities"[ti] OR "social identity"[ti] OR "social identities"[ti] OR "identity formation*"[ti] OR "identity maintenance"[ti] OR "identity change*"[ti] OR "identity process*"[ti] OR "identity related intervention*"[ti] OR "self conception"[ti] OR "self conceptions"[ti] OR ("identit*"[ti] AND ("construct*"[ti] OR "chang*"[ti] OR "creat*"[ti])) OR "self schema"[ti] OR "self schemata"[ti] OR "self schema*"[ti] OR "selfschema"[ti] OR "selfschemata"[ti] OR "selfschema*"[ti] OR "self definition"[ti] OR "self defin*"[ti] OR "selfdefinition"[ti] OR "selfdefin*"[ti] OR "possible self"[ti] OR "possible selves"[ti] OR "possible self*"[ti] OR "possible selv*"[ti] OR "future self"[ti] OR "future selves"[ti] OR "future self*"[ti] OR "future selve*"[ti] OR "prototype self"[ti] OR "prototype selves"[ti] OR "prototype self*"[ti] OR "prototype selv*"[ti]) AND ("Smoking"[majr] OR "Smoking"[ti] OR "Smoking Cessation"[majr] OR "Smoking Devices"[majr] OR "cigar"[ti] OR "cigars"[ti] OR "cigarette"[ti] OR "cigarettes"[ti] OR "tobacco"[ti] OR "smoker"[ti] OR "smoker*"[ti] OR "smokers"[ti] OR "smoking behavior*"[ti] OR "smoking behaviour*"[ti] OR "tobacco use cessation*"[ti] OR "nicotine use cessation"[ti] OR "quitting smoking*"[ti] OR "quit smoking*"[ti] OR "stop smoking*"[ti] OR "smoking reduction"[ti] OR "smoking abstinence"[ti] OR "cessation"[ti] OR "Exercise"[majr] OR "Exercise"[ti] OR "Exercis*"[ti]

OR "Physical Activity"[ti] OR "Physical Activit*" [ti] OR "Physically Activ*" [ti] OR "Physical Inactivit*" [ti] OR "Physically Inactiv*" [ti] OR "physical exercise*" [ti] OR "Sports"[majr] OR "sports"[ti] OR "sport"[ti] OR "Physical Fitness"[majr] OR "Athletic Performance"[majr] OR "fitness"[ti] OR "physical training"[ti] OR "athletic activity"[ti] OR "Athletic Performance"[ti]) NOT ("Animals"[mesh] NOT "Humans"[mesh]) NOT ("Comment"[Publication Type] OR "Editorial"[Publication Type] OR "Comment"[ti] OR "Editorial"[ti]))

Web of Science (<http://isiknowledge.com/wos>)

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TI=((("Psychological Identification" OR "Social Identification" OR "identity" OR "Self Concept" OR "Self Concept" OR "self perception*" OR "self image*" OR "self view*" OR "sense of self" OR "sense of identity" OR "sense of identities" OR "Social Identification" OR "Social Identification" OR "self identity" OR "self identities" OR "social identity" OR "social identities" OR "identity formation*" OR "identity maintenance" OR "identity change*" OR "identity process*" OR "identity related intervention*" OR "self conception" OR "self conceptions" OR (identit* AND (construct* OR chang* OR creat*)) OR "self schema" OR "self schemata" OR "self schema*" OR "selfschema" OR "selfschemata" OR "selfschema*" OR "self definition" OR "self defin*" OR "selfdefinition" OR "selfdefin*" OR "possible self" OR "possible selves" OR "possible self*" OR "possible selv*" OR "future self" OR "future selves" OR "future self*" OR "future selve*" OR "prototype self" OR "prototype selves" OR "prototype self*" OR "prototype selv*") AND ("Smoking" OR "Smoking" OR "Smoking Cessation" OR "Smoking Devices" OR "cigar" OR "cigars" OR "cigarette" OR "cigarettes" OR "tobacco" OR "smoker" OR "smoker*" OR "smokers" OR "smoking behavior*" OR "smoking behaviour*" OR "tobacco use cessation*" OR "nicotine use cessation" OR "quitting smoking*" OR "quit smoking*" OR "stop smoking*" OR "smoking reduction" OR "smoking abstinence" OR "cessation" OR "Exercise" OR "Exercise" OR "Exercis*" OR "Physical Activity" OR "Physical Activit*" OR "Physically Activ*" OR "Physical Inactivit*" OR "Physically Inactiv*" OR "physical exercise*" OR "Sports" OR "sports" OR "sport" OR "Physical Fitness" OR "Athletic Performance" OR "fitness" OR "physical training" OR "athletic activity" OR "Athletic Performance" OR "health behavior*" OR "health behaviour*") NOT ("veterinary" OR "rabbit" OR "rabbits" OR "animal" OR "animals" OR "mouse" OR "mice" OR "rodent" OR "rodents" OR "rat" OR "rats" OR "pig" OR "pigs" OR "porcine" OR "horse" OR "horses" OR "equine" OR "cow" OR "cows" OR "bovine" OR "goat" OR "goats" OR "sheep" OR "ovine" OR "canine" OR "dog" OR "dogs" OR "feline" OR "cat" OR "cats")) NOT (DT=("Editorial Material" OR "Book Review" OR "News Item" OR "Book Chapters") OR TI=("Editorial" OR "Book Review" OR "Comment") OR AK=("Editorial" OR "Book Review" OR "Comment"))

PsycINFO (<http://search.ebscohost.com/login.aspx?authtype=ip,uid&profile=lumc&defaultdb=psyh>)

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(TI(("Psychological Identification" OR "Social Identification" OR "identity" OR "Self Concept" OR "Self Concept" OR "self perception*" OR "self image*" OR "self view*" OR "sense of self" OR "sense of identity" OR "sense of identities" OR "Social Identification" OR "Social Identification" OR "self identity" OR "self identities" OR "social identity" OR "social identities" OR "identity formation*" OR "identity maintenance" OR "identity change*" OR "identity process*" OR "identity related intervention*" OR "self conception" OR "self conceptions" OR (identit* AND (construct* OR chang* OR creat*)) OR "self schema" OR "self schemata" OR "self schema*" OR "selfschema" OR "selfschemata" OR "selfschema*" OR "self definition" OR "self defin*" OR "selfdefinition" OR "selfdefin*" OR "possible self" OR "possible selves" OR "possible self*" OR "possible selv*" OR "future self" OR "future selves" OR "future self*" OR "future selve*" OR "prototype self" OR "prototype selves" OR "prototype self*" OR "prototype selv*") AND ("Smoking" OR "Smoking" OR "Smoking Cessation" OR "Smoking Devices" OR "cigar" OR "cigars" OR "cigarette" OR "cigarettes" OR "tobacco" OR "smoker" OR "smoker*" OR "smokers" OR "smoking behavior*" OR "smoking behaviour*" OR "tobacco use cessation*" OR "nicotine use cessation" OR "quitting smoking*" OR "quit smoking*" OR "stop smoking*" OR "smoking reduction" OR "smoking abstinence" OR "cessation" OR "Exercise" OR "Exercise" OR "Exercis*" OR "Physical Activity" OR "Physical Activit*" OR "Physically Activ*" OR "Physical Inactivit*" OR "Physically Inactiv*" OR "physical exercise*" OR "Sports" OR "sports" OR "sport" OR "Physical Fitness" OR "Athletic Performance" OR "fitness" OR "physical training" OR "athletic activity" OR "Athletic Performance" OR "health behavior*" OR "health behaviour*") NOT ("veterinary" OR "rabbit" OR "rabbits" OR "animal" OR "animals" OR "mouse" OR "mice" OR "rodent" OR "rodents" OR "rat" OR "rats" OR "pig" OR "pigs" OR "porcine" OR "horse" OR "horses" OR "equine" OR "cow" OR "cows" OR "bovine" OR "goat" OR "goats" OR "sheep" OR "ovine" OR "canine" OR "dog" OR "dogs" OR "feline" OR "cat" OR "cats")) **OR** ((MJ "Social Identity" OR MJ "Group Identity" OR MJ "Professional Identity" OR MJ "Identity Formation" OR MJ "Self-Concept") AND (MJ "Tobacco Smoking" OR MJ "Electronic Cigarettes" OR MJ "Passive Smoking" OR MJ "Smokeless Tobacco" OR MJ "Physical Activity" OR MJ "Actigraphy" OR MJ "Exercise" OR MJ "Sports" OR MJ "Athletes" OR MJ "Baseball" OR MJ "Basketball" OR MJ "Extreme Sports" OR MJ "Football" OR MJ "Judo" OR MJ "Martial Arts" OR MJ "Professional Sports" OR MJ "Soccer" OR MJ "Swimming" OR MJ "Tennis" OR MJ "Weightlifting")) NOT ("veterinary" OR "rabbit" OR "rabbits" OR "animal" OR "animals" OR "mouse" OR "mice" OR "rodent" OR "rodents" OR "rat" OR "rats" OR "pig" OR "pigs" OR "porcine" OR "horse" OR "horses" OR "equine" OR "cow" OR "cows" OR "bovine" OR "goat" OR "goats" OR "sheep" OR "ovine" OR "canine" OR "dog" OR "dogs" OR "feline" OR "cat" OR "cats")))) NOT (PT("book" OR "Dissertation Abstract") OR TI("Editorial" OR "Book Review" OR "Comment")))

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("Psychological Identification" OR "Social Identification" OR "identity" OR "Self Concept" OR "Self Concept" OR "self perception*" OR "self image*" OR "self view*" OR "sense of self" OR "sense of identity" OR "sense of identities" OR "Social Identification" OR "Social Identification" OR "self identity" OR "self identities" OR "social identity" OR "social identities" OR "identity formation*" OR "identity maintenance" OR "identity change*" OR "identity process*" OR "identity related intervention*" OR "self conception" OR "self conceptions" OR ((identity OR identities) AND (constructing OR change OR create)) OR "self schema" OR "self schemata" OR "self schema*" OR "selfschema" OR "selfschemata" OR "selfschema*" OR "self definition" OR "self defin*" OR "selfdefinition" OR "selfdefin*" OR "possible self" OR "possible selves" OR "possible self*" OR "possible selv*" OR "future self" OR "future selves" OR "future self*" OR "future selve*" OR "prototype self" OR "prototype selves" OR "prototype self*" OR "prototype selv*") AND ("Smoking" OR "Smoking" OR "Smoking Cessation" OR "Smoking Devices" OR "cigar" OR "cigars" OR "cigarette" OR "cigarettes" OR "tobacco" OR "smoker" OR "smoker*" OR "smokers" OR "smoking behavior*" OR "smoking behaviour*" OR "tobacco use cessation*" OR "nicotine use cessation" OR "quitting smoking*" OR "quit smoking*" OR "stop smoking*" OR "smoking reduction" OR "smoking abstinence" OR "cessation" OR "Exercise" OR "Exercise" OR "Exercis*" OR "Physical Activity" OR "Physical Activit*" OR "Physically Activ*" OR "Physical Inactivit*" OR "Physically Inactiv*" OR "physical exercise*" OR "Sports" OR "sports" OR "sport" OR "Physical Fitness" OR "Athletic Performance" OR "fitness" OR "physical training" OR "athletic activity" OR "Athletic Performance" OR "health behavior*" OR "health behaviour*")):ti

Embase (<http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=main&MODE=ovid&D=oemezd>)

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tion".ti OR "smoking abstinence".ti OR "cessation".ti OR exp *"Exercise"/ OR "Exercise".ti OR "Exercis*".ti OR "Physical Activity".ti OR "Physical Activit*".ti OR "Physically Activ*".ti OR "Physical Inactivit*".ti OR "Physically Inactiv*".ti OR "physical exercise*".ti OR exp *"Sport"/ OR "sports".ti OR "sport".ti OR *"Fitness"/ OR "fitness".ti OR "physical training".ti OR "athletic activity".ti OR "Athletic Performance".ti) NOT (exp "Animals"/ NOT exp "Humans"/ NOT ("editorial"/ OR "Comment".ti OR "Editorial".ti OR "book"/))

Emcare (<http://ovidsp.ovid.com/ovidweb.cgi?T=JS&NEWS=n&CSC=Y&PAGE=main&D=emcr>)

((*"Identity"/ OR "identity".ti OR "Self Concept".ti OR "self perception*".ti OR "self image*".ti OR "self view*".ti OR "sense of self".ti OR "sense of identity".ti OR "sense of identities".ti OR "Social Identification".ti OR "self identity".ti OR "self identities".ti OR "social identity".ti OR "social identities".ti OR "identity formation*".ti OR "identity maintenance".ti OR "identity change*".ti OR "identity process*".ti OR "identity related intervention*".ti OR "self conception".ti OR "self conceptions".ti OR ("identit*".ti AND ("construct*".ti OR "chang*".ti OR "creat*".ti)) OR "self schema".ti OR "self schemata".ti OR "self schema*".ti OR "selfschema".ti OR "selfschemata".ti OR "selfschema*".ti OR "self definition".ti OR "self defin*".ti OR "selfdefinition".ti OR "selfdefin*".ti OR "possible self".ti OR "possible selves".ti OR "possible self*".ti OR "possible selv*".ti OR "future self".ti OR "future selves".ti OR "future self*".ti OR "future selve*".ti OR "prototype self".ti OR "prototype selves".ti OR "prototype self*".ti OR "prototype selv*".ti) AND (exp *"Smoking"/ OR "Smoking".ti OR *"Smoking Cessation"/ OR exp *"Smoking Device"/ OR "cigar".ti OR "cigars".ti OR "cigarette".ti OR "cigarettes".ti OR "tobacco".ti OR "smoker".ti OR "smoker*".ti OR "smokers".ti OR "smoking behavior*".ti OR "smoking behaviour*".ti OR "tobacco use cessation*".ti OR "nicotine use cessation".ti OR "quitting smoking*".ti OR "quit smoking*".ti OR "stop smoking*".ti OR "smoking reduction".ti OR "smoking abstinence".ti OR "cessation".ti OR exp *"Exercise"/ OR "Exercise".ti OR "Exercis*".ti OR "Physical Activity".ti OR "Physical Activit*".ti OR "Physically Activ*".ti OR "Physical Inactivit*".ti OR "Physically Inactiv*".ti OR "physical exercise*".ti OR exp *"Sport"/ OR "sports".ti OR "sport".ti OR *"Fitness"/ OR "fitness".ti OR "physical training".ti OR "athletic activity".ti OR "Athletic Performance".ti) NOT (exp "Animals"/ NOT exp "Humans"/ NOT ("editorial"/ OR "Comment".ti OR "Editorial".ti OR "book"/))

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TI(("Psychological Identification" OR "Social Identification" OR "identity" OR "Self Concept" OR "Self Concept" OR "self perception*" OR "self image*" OR "self view*" OR "sense of self" OR "sense of identity" OR "sense of identities" OR "Social Identification" OR "Social Identification" OR "self identity" OR "self identities" OR "social identity" OR "social identities" OR "identity formation*" OR "identity maintenance" OR "identity change*" OR "identity

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Psychology and Behavioral Sciences Collection (Via PsycINFO)

Excluding Book Reviews

TI(("Psychological Identification" OR "Social Identification" OR "identity" OR "Self Concept" OR "Self Concept" OR "self perception*" OR "self image*" OR "self view*" OR "sense of self" OR "sense of identity" OR "sense of identities" OR "Social Identification" OR "Social Identification" OR "self identity" OR "self identities" OR "social identity" OR "social identities" OR "identity formation*" OR "identity maintenance" OR "identity change*" OR "identity process*" OR "identity related intervention*" OR "self conception" OR "self conceptions" OR (identit* AND (construct* OR chang* OR creat*)) OR "self schema" OR "self schemata" OR "self schema*" OR "selfschema" OR "selfschemata" OR "selfschema*" OR "self definition" OR "self defin*" OR "selfdefinition" OR "selfdefin*" OR "possible self" OR "possible selves" OR "possible self*" OR "possible selv*" OR "future self" OR "future selves" OR "future self*" OR "future selve*" OR "prototype self" OR "prototype selves" OR "prototype self*" OR "prototype selv*") AND ("Smoking" OR "Smoking" OR "Smoking Cessation" OR "Smoking Devices" OR "cigar" OR "cigars" OR "cigarette" OR "cigarettes" OR "tobacco" OR "smoker" OR "smoker*" OR "smokers" OR "smoking behavior*" OR "smoking behaviour*" OR "tobacco use cessation*" OR "nicotine use cessation" OR "quitting smoking*" OR "quit

smoking*" OR "stop smoking*" OR "smoking reduction" OR "smoking abstinence" OR "cessation" OR "Exercise" OR "Exercise" OR "Exercis*" OR "Physical Activity" OR "Physical Activit*" OR "Physically Activ*" OR "Physical Inactivit*" OR "Physically Inactiv*" OR "physical exercise*" OR "Sports" OR "sports" OR "sport" OR "Physical Fitness" OR "Athletic Performance" OR "fitness" OR "physical training" OR "athletic activity" OR "Athletic Performance" OR "health behavior*" OR "health behaviour*") NOT ("veterinary" OR "rabbit" OR "rabbits" OR "animal" OR "animals" OR "mouse" OR "mice" OR "rodent" OR "rodents" OR "rat" OR "rats" OR "pig" OR "pigs" OR "porcine" OR "horse" OR "horses" OR "equine" OR "cow" OR "cows" OR "bovine" OR "goat" OR "goats" OR "sheep" OR "ovine" OR "canine" OR "dog" OR "dogs" OR "feline" OR "cat" OR "cats"))

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TI(("Psychological Identification" OR "Social Identification" OR "identity" OR "Self Concept" OR "Self Concept" OR "self perception*" OR "self image*" OR "self view*" OR "sense of self" OR "sense of identity" OR "sense of identities" OR "Social Identification" OR "Social Identification" OR "self identity" OR "self identities" OR "social identity" OR "social identities" OR "identity formation*" OR "identity maintenance" OR "identity change*" OR "identity process*" OR "identity related intervention*" OR "self conception" OR "self conceptions" OR (identit* AND (construct* OR chang* OR creat*)) OR "self schema" OR "self schemata" OR "self schema*" OR "selfschema" OR "selfschemata" OR "selfschema*" OR "self definition" OR "self defin*" OR "selfdefinition" OR "selfdefin*" OR "possible self" OR "possible selves" OR "possible self*" OR "possible selv*" OR "future self" OR "future selves" OR "future self*" OR "future selve*" OR "prototype self" OR "prototype selves" OR "prototype self*" OR "prototype selv*") AND ("Smoking" OR "Smoking" OR "Smoking Cessation" OR "Smoking Devices" OR "cigar" OR "cigars" OR "cigarette" OR "cigarettes" OR "tobacco" OR "smoker" OR "smoker*" OR "smokers" OR "smoking behavior*" OR "smoking behaviour*" OR "tobacco use cessation*" OR "nicotine use cessation" OR "quitting smoking*" OR "quit smoking*" OR "stop smoking*" OR "smoking reduction" OR "smoking abstinence" OR "cessation" OR "Exercise" OR "Exercise" OR "Exercis*" OR "Physical Activity" OR "Physical Activit*" OR "Physically Activ*" OR "Physical Inactivit*" OR "Physically Inactiv*" OR "physical exercise*" OR "Sports" OR "sports" OR "sport" OR "Physical Fitness" OR "Athletic Performance" OR "fitness" OR "physical training" OR "athletic activity" OR "Athletic Performance" OR "health behavior*" OR "health behaviour*") NOT ("veterinary" OR "rabbit" OR "rabbits" OR "animal" OR "animals" OR "mouse" OR "mice" OR "rodent" OR "rodents" OR "rat" OR "rats" OR "pig" OR "pigs" OR "porcine" OR "horse" OR "horses" OR "equine" OR "cow" OR "cows" OR "bovine" OR "goat" OR "goats" OR "sheep" OR "ovine" OR "canine" OR "dog" OR "dogs" OR "feline" OR "cat" OR "cats"))

Supplement 4 – List of potential factors which may facilitate or hinder the formation and maintenance of identities reflecting engagement in PA and abstinence from smoking/vaping

Suggested facilitator	Iden- tity formation, maintenance or both	Number of studies	References	Suggested barrier	Iden- tity formation, maintenance or both	Number of studies	References
Identity reflecting engagement in physical activity							
Engagement in physical activity.	Both	8	52, 53, 54, 58, 68, 70, 88, 93	Physical restrictions.	Both	3	68, 73, 86
Physical activity self-efficacy.	Both	5	52, 53, 54, 87, 88	Finding the time.	Both	3	52, 70, 87
Sense of belonging to and social inter- actions with a physically active group.	Both	5	52, 70, 87, 93	Feeling guilty for prioritizing physical activity over other responsibilities (e.g., domestic, marital).	Both	3	52, 70, 87
Social support.	Both	4	52, 68, 70, 73	Self-perceptions that body and physical capacities do not match that of some- one with a strong PA-identity.	Both	3	54, 68, 86
Wanting to be a role model.	Both	3	73, 86, 87	Low confidence in physical capabilities due to negative past experiences.	Both	2	86, 87
Noticing positive outcomes when engaging in physical activity.	Both	3	52, 54, 68	Fear of injury.	Both	2	86, 87
Positive self-perceptions of physical appearance and capacities.	Both	3	53, 54, 68	Age-related physical decline.	Both	2	86, 87
Having PA aspirations.	Both	2	68, 73	Engaging in physical activity out of ac- countability (e.g., to a doctor).	Both	1	52
Resilience.	Both	2	68, 73	Placing one unrelated identity (e.g., altruistic identity) above all others.	Both	1	68
Valuing the health benefits of physical activity.	Both	2	73, 93	Seeing exercise as performance and not an enjoyable leisure.	Both	1	54
Feeling autonomous and in control to integrate PA into routine.	Both	2	52, 87	In patient populations, engaging in physical activity exacerbates symptoms.	Maintenance	2	65, 76
Positive self-views of own age and health status.	Both	2	68, 73	Decreased physical activity self-efficacy due to diminished physical capabilities.	Maintenance	2	65, 76
Feeling accomplished and empowered when engaging in PA.	Both	1	52				

Suggested facilitator	Iden- tity formation, maintenance or both	Number of studies	References	Suggested barrier	Iden- tity formation, maintenance or both	Number of studies	References
Perceiving PA as important or necessary to be healthy.	Both	1	54				
Valuing / enjoying PA.	Both	1	53				
Appearance and physical capacities matching societal standards associated with being physically active.	Both	2	54, 58				
Domains of Self-Determination Theory ^a	Formation	1	89				
Identity reflecting abstinence from smoking/vaping							
Abstinence from smoking/vaping.	Both	6	77, 78, 81, 82, 83, 92	(Residual) attraction to smoking/vaping.	Both	5	77, 78, 81, 83, 91
Coping with urges to smoke (e.g., alternative behaviors, committing to staying smoke free, taking ownership of behavior). ^a	Maintenance	2	77, 83	Low self-determination to change. ^a	Formation	1	82
Redefinition of smoking from something enjoyable and relaxing to something undesirable, unwise, costly. ^a	Formation	1	77	Low perceived importance of quitting. ^a	Formation	1	82
Family environment supportive of abstinence ^a	Formation	1	77	Discomfort about quitting. ^a	Formation	1	82
Smoking bans. ^a	Formation	1	77	Extrinsically motivated cessation. ^a	Formation	1	82
Wanting to conform to societal norms regarding smoking. ^a	Formation	1	77	Urges. ^a	Both	1	82
Access to information about the health risks of smoking. ^a	Formation	1	77	Expecting urges to naturally dissolve after quitting. ^a	Formation	1	82
Illness fears. ^a	Formation	1	77	Positive beliefs about the benefits of smoking. ^a	Formation	1	82
Commitment to quitting smoking. ^a	Both	1	77	Enjoying smoking.	Both	1	82
Ownership over decision to quit. ^a	Both	1	77	Not being serious about quitting.	Formation	1	92

Suggested facilitator	Identity formation, maintenance or both	Number of studies	References	Suggested barrier	Identity formation, maintenance or both	Number of studies	References
Experiencing fewer urges. ^a	Formation	1	83	Viewing e-cigarettes as a practical means to quit.	Both	1	84
Mastery at resisting urges. ^a	Formation	1	83	Ambivalence towards e-cigarettes.	Both	1	84
Wanting to be a role model by quitting. ^a	Formation	1	83	Viewing smoking as an addiction.	Maintenance	1	81
Acceptance that relapse is part of the quitting process. ^a	Formation	1	83				
Quitting smoking. ^a	Maintenance	1	77				
Feeling proud of having quit. ^a	Maintenance	1	77				
Reaffirming the new nonsmoker identity. ^a	Maintenance	1	77				
Reaffirming reasons to quit. ^a	Maintenance	1	77				
Integrating positive responses to quitting from friends and family into one's sense of self. ^a	Maintenance	1	77				
Comparing the former smoker-self to the current nonsmoker self. ^a	Maintenance	1	77				
Pride at being a nonsmoker.	Maintenance	1	81				
Greater regard for nonsmokers.	Maintenance	1	81				

Notes:

a. Factors related to tobacco smoking specifically, not vaping.