

Which domains of the theoretical domains framework should be targeted in interventions to increase adherence to antihypertensives? A systematic review

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Nonadherence to antihypertensives is prevalent and is associated with poorer health outcomes. This study aimed to identify psychological factors associated with adherence in patients taking antihypertensives as these are potentially modifiable, and can, therefore, inform the development of effective interventions to increase adherence. PubMed, EMBASE and PsychINFO were searched to identify studies that tested for significant associations between psychological domains and adherence to antihypertensives. The domains reported were categorized according to the Theoretical Domains Framework. The quality of included studies was evaluated using the National Institute for Clinical Excellence critical appraisal of questionnaire checklist. Thirty-one studies were included. Concerns about medicines (a subdomain of 'beliefs about consequences') and 'beliefs about capabilities' consistently showed association with adherence in over five studies. Healthcare professionals should actively ask patients if they have any concerns about their antihypertensives and their belief in their ability to control their blood pressure through taking antihypertensives.

Keywords: adherence, hypertension, Theoretical Domains Framework

Abbreviation: TDF, Theoretical Domains Framework

INTRODUCTION

Adherence to antihypertensives, is associated with improved health outcomes [1]. However, adherence within the first year of being prescribed antihypertensive drugs is estimated to be less than 50%, with estimates of adherence ranging from 30 to 70% [2]. Uncontrolled blood pressure persists in nonadherent patients, with almost 75% of patients failing to reach optimal blood pressure control [3]. The risk of hospitalization has been found to be significantly higher in patients with hypertension who were nonadherent to antihypertensives [4].

Interventions that have been developed to increase adherence have been found to be moderately effective in reducing blood pressure [4]. However, Morrissey *et al.* [4] noted that the effects of interventions can be limited and have varied effects often because of the 'lack of explicit rationale for the intervention choice and the use of inappropriate methods to design the interventions' [1].

The use of theory can help in the design of behaviour change interventions that are more likely to be effective. The TDF was developed and validated to summarize a comprehensive range of domains, from 33 psychological theories that can influence behaviour. It consists of 14 individual, nonoverlapping domains that are summarized in Table 1. Few studies have used theories, such as the TDF to inform interventions to increase adherence to antihypertensives. However, Morrissey *et al.* [4] conducted a review of interventions designed to increase antihypertensives and categorized their components using the Theoretical Domains Framework (TDF) [5]. Morrissey *et al.* [4] did not reach any definitive conclusions about the domains that were likely to result in a greater reduction in both SBP and DBP whenever included in the intervention. In addition, they did not find that more complex interventions (those addressing a greater number of domains) were more likely to be effective. Although interventions addressing 'memory, attention and decision processes' were associated with a larger effect size, the authors noted that this domain was present in most studies and the remaining interventions (which did not address 'memory, attention and decision processes') may have only provided minimal support, which may be why they were less effective.

Although Morrissey *et al.* [4] identified the intervention components that have been addressed by interventions, to date, no study has synthesized evidence on the psychological factors that are associated with nonadherence to antihypertensives. This study aimed to identify psychological factors associated with adherence in patients taking antihypertensives, mapped onto the TDF, in order to inform the development of more targeted and effective interventions. Comparison between the results of the current review, and the study by Morrissey *et al.* [4], was used to

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TABLE 1. The Theoretical Domains Framework

Theoretical domain	Definition
Knowledge	An awareness of the existence of something
Skills	An ability or proficiency acquired through practice
Social/professional role and identity	A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting
Beliefs about capabilities	Acceptance of the truth, reality or validity about an ability, talent or facility that a person can put to constructive use
Optimism	The confidence that things will happen for the best or that desired goals will be attained
Beliefs about consequences	Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation
Reinforcement	Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus
Intentions	A conscious decision to perform a behaviour or a resolve to act in a certain way
Goals	Mental representations of outcomes or end states that an individual wants to achieve
Memory, attention and decision processes	The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives
Environmental context and resources	Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence and adaptive behaviour
Social influences	Those interpersonal processes that can cause individuals to change their thoughts, feelings or behaviours
Emotion	A complex reaction pattern, involving experiential, behavioural and physiological elements, by which the individual attempts to deal with a personally significant matter or event
Behavioural regulation	Anything aimed at managing or changing objectively observed or measured actions

Data from [5].

determine whether there are promising domains that should be considered in interventions for adherence to antihypertensives, which have not yet been sufficiently considered or tested.

METHODS

Search strategy

Studies were retrieved from PubMed, EMBASE and PsychINFO using search terms related to hypertension, adherence, determinants and quantitative studies (see, e. g. Supplementary File 1, <http://links.lww.com/HJH/B901>). The bibliography list of selected articles were searched to identify further studies. Studies were included if they tested for statistical associations between adherence and psychological/motivational determinants in patients over 18 years of age taking antihypertensives for hypertension. There were no restrictions on the geographical location or the intensity of antihypertensive treatment. Studies were excluded if they included patients who did not have hypertension or were not published in the English language. Studies were also excluded if insufficient information was given to allow mapping of determinants of adherence on to the TDF.

Review process

The search results were exported to Endnote. Duplicates were removed and the titles and abstracts of the articles were screened by M.R. A 10% random sample was screened by S.G. (agreement level 100%). Full texts of eligible articles were then retrieved. S.G. and M.R. independently screened all full text articles and all disagreements were resolved through discussion.

S.G. and M.R. carried out a quality assessment of the included studies using the National Institute of Clinical Excellence critical appraisal checklist for questionnaires [6]. Ten percent of studies were independently reviewed by both S.G. and M.R. and inter-rater reliability was 100%. Studies were not excluded on the basis of the quality

assessment, rather the quality assessment was used to assess the strength of the evidence.

Data were extracted related to country, study design, sample size, age and gender of participants and psychological factors associated with adherence. M.R., S.G. and D.M. extracted the data. Ten percent of the studies that M.R. and D.M. extracted data for were checked by S.G. and the agreement rate was 100%.

Psychological factors were mapped on to the TDF by M. R., S.G. and D.M. Subdomains were developed for domains for which more than one clearly distinguishable component was identified after reviewing the studies. G.J. checked the TDF mapping for all included studies and any disagreements were resolved through discussion.

RESULTS

Thirty-one studies were included (Fig. 1).

Table 2 describes the characteristics of included studies (see Supplementary File 2 for more detail, <http://links.lww.com/HJH/B901>). Overall the studies included a wide range of countries including high-income, middle-income and low-income countries and spanning five continents (no studies were identified from Australia). The majority of studies used a cross-sectional design. Sample sizes ranged from 115 to 8692. Studies differed in the length of time patients needed to have been on antihypertensives to be eligible for recruitment. Some did not specify any length of time, whereas others ranged from 3 to 12 months. All but one study used self-report to measure adherence.

The majority of studies assessing beliefs about consequences used the Beliefs about Medicines Questionnaire [38] that divides beliefs about medicines into necessity and concerns. Necessity assesses beliefs about the need for prescribed medication. Concerns assesses beliefs about the danger of dependence on medicines, and short-term and long-term toxicity. Necessity and concerns are, therefore, reported as two separate subdomains of 'beliefs about consequences' where these were reported separately in the

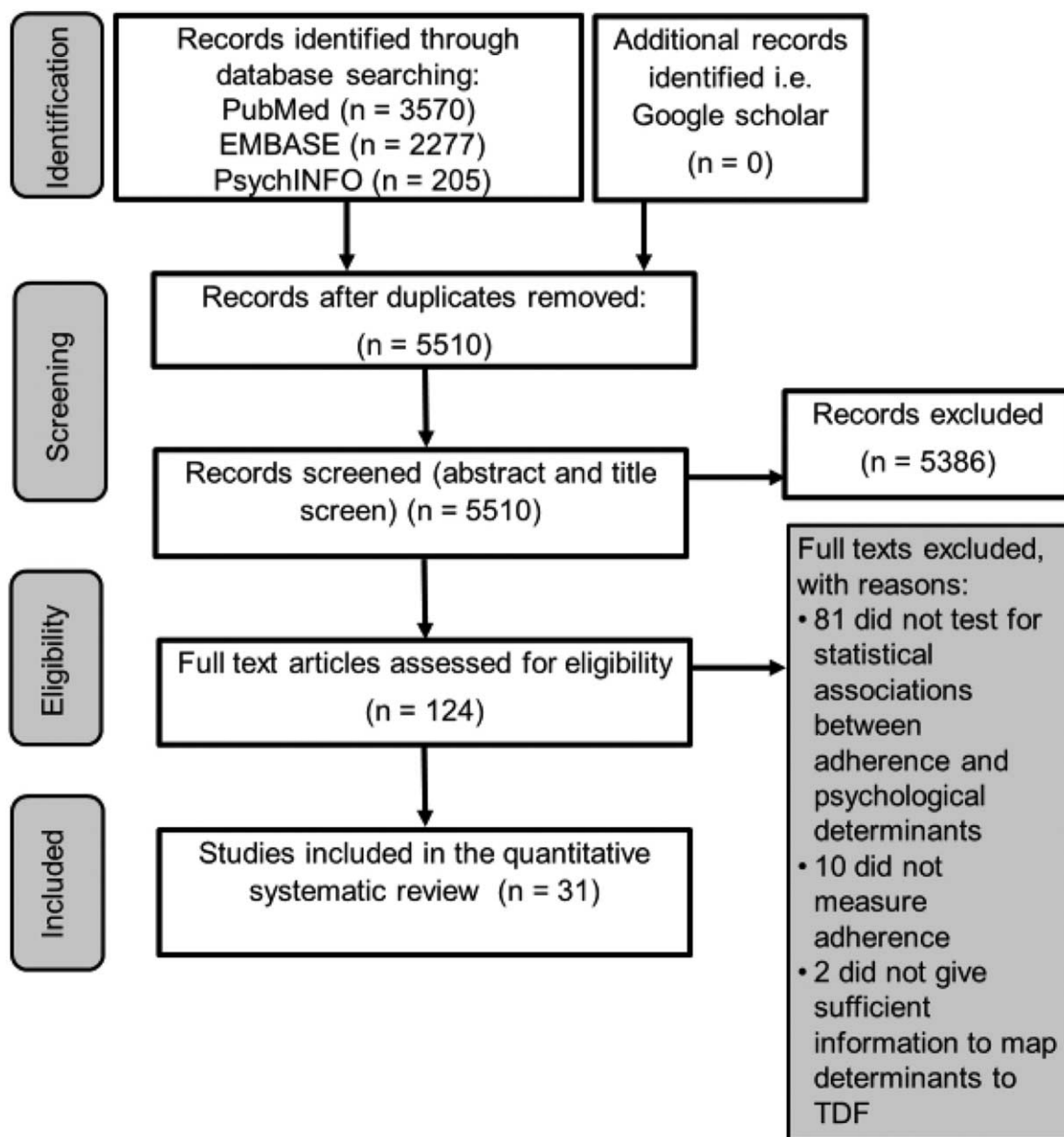


FIGURE 1 PRISMA diagram showing studies identified.

original studies. Environmental factors reported in the studies either related to the complexity of the medication regime or the resources available to the patients. As they appeared to be quite different concepts they are reported as separate subdomains. Finally, 'social influences' were either from family and friends or from healthcare professionals. Again, as these seemed to be two separate concepts, they are reported as two subdomains.

None of the studies tested all domains of the TDF for associations with medication adherence. The number of studies testing each domain/subdomain, and the proportion of these that found a significant association with adherence, are shown in Table 3. Thirteen out of 14 of the domains were tested in less than half of the studies.

The domains most frequently tested were 'beliefs about consequences', 'knowledge', 'environmental context and resources' and 'social influences' (Table 3). All studies that measured skills, measured health literacy; no studies measured physical skills. No studies included the domain of 'goals'. In addition: 'skills', 'social professional identity', 'optimism', 'emotion' and 'behavioural regulation' were investigated in less than 10% of the studies.

Concerns about medicines (a subdomain of 'beliefs about consequences'), and 'beliefs about capabilities', were tested in over three studies, all of which found them to be statistically significant (Table 3). 'Memory/attention/decision processes', health literacy (a subdomain of 'skills'), 'social identity' and 'intentions' were also found to be

TABLE 2. Study characteristics

Author, year	Country	Study design	Sample size	Participants mean age (MA) and gender
Ahn and Ham, 2016 [7]	South Korea	Cross-sectional	289	MA = 69, Male = 66%, Female = 44%
Al-Ramahi <i>et al.</i> , 2019 [8]	Palestine	Cross-sectional	450	MA = 59, Male = 44%, Female = 56. %
Schoenthaler <i>et al.</i> , 2016 [9]	USA	Randomized clinical trial	1058	MA = 57, Male = 29. % Female = 71 %
Aziz <i>et al.</i> , 2020 [10]	Malasia	Cross-sectional	160	MA = 65, Male = 71 %,Female = 29%
Bane <i>et al.</i> , 2006 [11]	Northern Ireland	Cross-sectional	139	MA = 52, Male = 51 % Female = 49%
Da Silva Barreto <i>et al.</i> , 2014 [12]	Brazil	Cross-sectional	422	MA = not reported, Male = 41%, Female = 59%
Berisa and Dedefo, 2017 [13]	Ethiopia	Cross-sectional	172	MA = 52, Male = 44% Female = 56%
Boima <i>et al.</i> , 2017 [14]	Sub-Saharan Africa	Cross-sectional	357	MA = 57, Male = 43%, Female = 53%
Dillon <i>et al.</i> , [15] 2018	Ireland	Prospective cohort study	1211	MA = 7, Male = 47%, Female = 53%
Durand <i>et al.</i> , 2018 [16]	UK	Cross-sectional	204	MA = 70, Male = 58%, Female = 42&
Fernandez-Arias <i>et al.</i> , 2014 [17]	Peru	Cross-sectional	115	MA = 63, Male = 33%, Female = 67%
Ghembaza <i>et al.</i> , 2014 [18]	Algeria	Cross-sectional	462	MA = 62, Male = 24%, Female = 76%
Hassan <i>et al.</i> , 2019 [19]	Malaysia	Cross-sectional	240	MA = 54.5, Male = 50%, Female = 50%
Horne <i>et al.</i> , 2010 [20]	UK	Longitudinal	230	MA = 67, Male = 88%, Female = 12%
Karakurt and Kasikci, 2012 [21]	Turkey	Descriptive	750	MA = 61, Male = 22%, Female = 88%
Li <i>et al.</i> , 2012 [22]	Taiwan	Cross-sectional	200	MA = 60, Male = 62%, Female = 38%
Lo <i>et al.</i> , 2016 [23]	China	Cross-sectional	195	MA = 76, Male = 21%, Female = 79%
Lor <i>et al.</i> , 2019 [24]	USA	Cross-sectional	1355	MA = 62, Male = 24%, Female = 76%
Morrison <i>et al.</i> , 2015 [25]	11 European countries	Cross-sectional	2595	MA 54–64, Male = 64–51%, Female 36–49% (reported separately for each country)
Nair <i>et al.</i> , 2011 [26]	USA	Cross-sectional	8692	MA = 63, Male = 46%, Female = 56%
Osamor and Owumi, 2011 [27]	Nigeria	Cross-sectional	440	MA = 60, Male = 35%, Female = 65%
Patel and Taylor, 2022 [28]	USA	Prospective, cross-sectional	240	MA = 59, Male = 45, Female = 5%
Quine <i>et al.</i> 2011 [29]	UK	Longitudinal	934	MA = 69, Male = 42%, Female = 58%
Rahmawati and Bajorek, 2018 [30]	Indonesia	Cross-sectional	384	MA = 66, Male = 25%, Female = 75%
Sarkar <i>et al.</i> , 2018 [31]	India	Cross-sectional	400	Over 60 = 41%, 40–59 = 52%, 30–39 = 7%, Male = 43%, Female = 57%
Da Silva Barreto, 2014 [32]	Brazil	Cross-sectional	422	Female = 59.48% 63.25% over the age of 60
Tan <i>et al.</i> , 2020 [33]	Malaysia	Cross-sectional	384	MA = 57, Male = 40 Female = 60%
Turner <i>et al.</i> , 2009 [34]	USA	Cross-sectional	202	MA = 65, Male = 34%, Female = 66%
Wang <i>et al.</i> , 2002 [35]	USA	Cross-sectional	496	MA = not known, Male = 39%, Female = 61%
Yue <i>et al.</i> , 2014 [36]	China	Cross-sectional	232	MA = 66, Male = 48%, Female = 52%
Zhang <i>et al.</i> 2018 [37]	China	Cross-sectional	1916	MA = 72, Male = 40%, Female = 60. %

TABLE 3. Determinants of antihypertensive adherence mapped on to the Theoretical Domains Framework, along with the number of studies and significant studies, subdomains totals are indicated when these were seen in the data

TDF domain (subdomain)	Subdomain	Number of studies testing for this domain/subdomain(%)	Number of studies showing significant association with adherence (percent of studies that tested for association)
Knowledge		14 (44)	11 (79)
Skills	Health literacy	2(6)	2 (100)
Social/professional role and identity		2(6)	2 (100)
Beliefs about capabilities		6(19)	6 (100)
Optimism		2(6)	1 (50)
Beliefs about consequences		18 (58)	15 (83)
	Concerns	7(12)	7 (100)
	Necessity	8(25)	5(63)
	Combined concerns and necessity (when not presented separately)	6 (19)	3 (50)
Reinforcement		5(16)	3 (60)
Intentions		2(6)	2 (100)
Goals		0(0)	N/A
Memory/attention/decision processes		2(6)	2 (100)
Environmental context and resources		11 (35)	11 (100)
	Resources	7(12)	5(71)
	Complexity of regimen	8(25)	4(50)
Social influences		10 (32)	6 (60)
	Family and friends	7(23)	3(43)
	Healthcare professionals	7(23)	3(43)
Emotion		2(6)	1 (50)
Behavioural regulation		1 (3)	1 (100)

significantly associated with adherence in all studies that tested for them but these domains were only tested in under three (10%) studies (Table 3). In addition, the domain of 'knowledge' and subdomain of resources (from 'environmental context and resources') were significantly associated with adherence in at least 70% of studies where they were measured. All domains tested, apart from 'social influences', were observed to be significantly associated with adherence at least 50% of the time.

The main issues concerning the quality of included studies related to lack of reporting of response rates in some studies and lack of information about the development, reliability and validity of some of the questionnaires used. Although the majority of studies used questionnaires that had previously had their reliability and validity established, some did not. Upon reviewing the domains that had inconclusive evidence as to whether or not they were significantly associated with adherence to antihypertensive medication, the differences in findings did not appear to be explained by variable quality of the studies.

DISCUSSION

Our review has found that all the domains of the TDF have been shown to be significantly associated with adherence to antihypertensives, apart from 'goals' that has not been tested. However, the consistency of findings across studies varied for the different domains and some domains have been more extensively tested than others. Only 'environmental context and resources' was tested in more than half of the included studies, and eight domains were tested in less than three of the included studies. The most commonly measured domains were 'knowledge', 'beliefs about consequences' and 'environmental context and resources', tested in more than 40% of included studies. Notably, all seven studies that tested for associations between concerns about medicines, a subdomain, of 'beliefs about consequences', found a significant association with adherence. Similarly, all six studies that tested for associations between 'beliefs about capabilities' and adherence to hypertension found a significant association.

Comparison to existing literature

Morrissey *et al.* [4] found that the TDF domains that were commonly targeted in interventions to reduce nonadherence of antihypertensives were: 'memory attention and decision processes' (31/31 interventions) 'environmental context and resources' (27/31 interventions), 'social influences' (22/31 interventions) and 'knowledge' (20/31 interventions). Our review has shown that other domains/ subdomains that may be important to target in future interventions are concerns about medicines and 'beliefs about capabilities'. Those with less concerns about medicines and a greater belief in their ability to control their illness were more likely to take their medicines; however, 'beliefs about capabilities' has not been well tested in existing interventions. A study comparing healthcare professionals' to patients' concerns about safe care for adults with complex needs has shown that patients have more concerns than healthcare professionals about medicines' side effects and interactions, and that that is a potential barrier to adherence [39].

Implications for practice

Our findings suggest that healthcare professionals should focus on addressing patients' concerns about their medicines and their belief in their ability to control their blood pressure, through taking their medicines. Whilst higher knowledge was found to be associated with greater adherence in over three quarters of studies that tested for this, a higher level of health literacy was also associated with greater adherence. This suggests that in order to increase knowledge, healthcare professionals need to provide information in a way that is accessible to patients. Previous research [40] has shown the importance of tailoring interventions to address individual causes of nonadherence. The domains of the TDF that are associated with nonadherence address a broad range of factors some of which are likely to be associated with intentional nonadherence, for example, 'knowledge' and concerns about medicines, and others, which may be associated with unintentional nonadherence, such as 'memory' attention and decision 'processes' and 'behavioural regulation'. Understanding the types of factors that are likely to cause nonadherence can be helpful in knowing what questions to ask patients, and then tailoring interventions towards specific barriers to adherence and potential facilitators that are identified.

Implications for research

There are some gaps in the literature. No studies were found that tested for association between adherence to antihypertensives and the domain of 'goals'. In addition, 'behavioural regulation' was only each tested in one study, and six further domains were tested in two or fewer studies. These include several domains, which measure aspects of unintentional nonadherence ('memory', 'behavioural regulation', 'emotion', 'skills'), suggesting that the components of unintentional nonadherence specifically may be insufficiently investigated. Importantly, no study has included all the domains of the TDF, and therefore, a multivariate analysis of all the domains, allowing for interactions between them has not been tested. Future research should address this gap.

Strengths and limitations

To our knowledge, this is the first review synthesizing evidence of psychological factors associated with adherence. Limitations were that studies that were not published in English were excluded, which could have led to the exclusion of relevant articles. However, we identified studies in high-income, middle-income and low-income countries. There is also the possibility of publication bias with studies only being submitted for publication if they showed a significant effect, especially given the high level of significance observed across all domains measured.

Concluding remarks

The review findings showed that concerns about medicines and personal beliefs about capabilities to take medicine to control hypertension were key factors associated with adherence to antihypertensives. However, 'beliefs about capabilities' is currently incorporated into few of the interventions that have been designed to increase adherence [4].

Knowledge about hypertension, is also likely to be associated with adherence. More investigation is needed in relation to factors that may be associated with unintentional nonadherence. Healthcare professionals can potentially increase adherence by asking patients about all the above factors and tailoring their consultations and recommendations accordingly. Researchers should more comprehensively measure a wider range of potential barriers and facilitators to adherence.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Sokol MC, Mcguigan KA, Verbrugge RR, Epstein RS. Impact of medication adherence on hospitalization risk and healthcare cost. *Med Care* 2005; 43:521–530.
- Vrijens B, Vincze G, Kristanto P, Urquhart J, Burnier M. Adherence to prescribed antihypertensive drug treatments: longitudinal study of electronically compiled dosing histories. *BMJ* 2008; 336:1114–1117.
- Anonymous. Poor medication adherence increases healthcare costs. *Pharmaco Economics Outcomes News* 2005; 480:5.
- Morrissey E, Durand H, Nieuwlaat R, Navarro T, Haynes R, Walsh J, Molloy GJ. Effectiveness and content analysis of interventions to enhance medication adherence and blood pressure control in hypertension: a systematic review and meta-analysis. *Psychol Health* 2017; 32:1195–1232.
- Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implement Sci* 2012; 7:1–17.
- Nice.org.uk. Methodology checklist. [online] 2014 Available at: <https://www.nice.org.uk/guidance/cg188/evidence/appendix-kmethodology-checklist-pdf-6958881110>. [Accessed 29 November 2020]
- Ahn YH, Ham OK. Factors associated with medication adherence among medical-aid beneficiaries with hypertension. *West J Nurs Res* 2016; 38:1298312.
- Al-Ramahi R. Adherence to medications and associated factors: a cross-sectional study among Palestinian hypertensive patients. *J Epidemiol Glob Health* 2015; 5:125–132.
- Schoenthaler AM, Butler M, Chaplin W, Tobin J, Ogedegbe G. Predictors of changes in medication adherence in blacks with hypertension: moving beyond cross-sectional data. *Ann Behav Med* 2016; 50:642–652.
- Aziz F, Malek S, Mhd Ali A, Wong MS, Mosleh M, Milow P. Determining hypertensive patients' beliefs towards medication and associations with medication adherence using machine learning methods. *Peer J* 2020; 8:e8286.
- Bane C, Hughes CM, McElnay JC. Determinants of medication adherence in hypertensive patients: an application of self-efficacy and the Theory of Planned Behaviour. *Int J Pharm Pract* 2006; 14:197–204.
- Da Silva Barreto M, Reiners AA, Marcon SS. Knowledge about hypertension and factors associated with the nonadherence to drug therapy. *Revista latino-americana de enfermagem* 2014; 22:491–498.
- Berisa HD, Dedefo MG. Nonadherence related factors to antihypertensive medications among hypertensive patients on follow up at Nedjo General Hospital in west Ethiopia. *Open Public Health J* 2018; 11:62–71.
- Boima V, Ademola AD, Oduola AO, Agyekum F, Nwafor CE, Cole H, et al. Factors associated with medication nonadherence among hypertensives in Ghana and Nigeria. *Int J Hypertens* 2015; 2015:205716.
- Dillon P, Phillips LA, Gallagher P, Smith SM, Stewart D, Cousins G. Assessing the multidimensional relationship between medication beliefs and adherence in older adults with hypertension using polynomial regression. *Ann Behav Med* 2018; 52:146–156.
- Durand H, Hayes P, Harhen B, Conneely A, Finn DP, Casey M, et al. Medication adherence for resistant hypertension: assessing theoretical predictors of adherence using direct and indirect adherence measures. *Br J Health Psychol* 2018; 23:949–966.
- Fernandez-Arias M, Acuna-Villaorduna A, Miranda JJ, Diez-Canseco F, Malaga G. Adherence to pharmacotherapy and medication-related beliefs in patients with hypertension in Lima, Peru. *PLoS One* 2014; 9:e112875.
- Ghembaza MA, Senoussaoui Y, Tani MK, Meguenni K. Impact of patient knowledge of hypertension complications on adherence to antihypertensive therapy. *Curr Hypertens Rev* 2014; 10:41–48.
- Hassan NB, Hasanah CI, Foong K, Naing L, Awang R, Ismail SB, et al. Identification of psychosocial factors of noncompliance in hypertensive patients. *J Hum Hypertens* 2006; 20:23–29.
- Horne R, Clatworthy J, Hankins M, Investigators ASCOT. High adherence and concordance within a clinical trial of antihypertensives. *Chronic Illn* 2010; 6:243–251.
- Karakurt P, Kasicki M. Factors affecting medication adherence in patients with hypertension. *J Vasc Nurs* 2012; 30:118–126.
- Li WW, Kuo CT, Hwang SL, Hsu HT. Factors related to medication nonadherence for patients with hypertension in Taiwan. *J Clin Nurs* 2012; 21:1816–1824.
- Lo SH, Chau JP, Woo J, Thompson DR, Choi KC. Adherence to antihypertensive medication in older adults with hypertension. *J Cardiovasc Nurs* 2016; 31:296–303.
- Lor M, Koleck TA, Bakken S, Yoon S, Dunn Navarra AM. Association between health literacy and medication adherence among hispanics with hypertension. *J Racial Ethn Health Disparities* 2019; 6:517–524.
- Morrison VL, Holmes EAF, Parveen S, Plumpton CO, Clyne W, De Geest S, et al. Predictors of self-reported adherence to antihypertensive medicines: a multinational, cross-sectional survey. *Value in Health* 2015; 18:206–216.
- Nair KV, Belletti DA, Doyle JJ, Allen RR, McQueen RB, Saseen JJ, et al. Understanding barriers to medication adherence in the hypertensive population by evaluating responses to a telephone survey. *Patient Prefer Adherence* 2011; 5:195–206.
- Osamor PE, Owumi BE. Factors associated with treatment compliance in hypertension in southwest Nigeria. *J Health Popul Nutr* 2011; 29:619–628.
- Patel RP, Taylor SD. Factors affecting medication adherence in hypertensive patients. *Ann Pharmacother* 2002; 36:40–45.
- Quine L, Steadman L, Thompson S, Rutter DR. Adherence to antihypertensive medication: proposing and testing a conceptual model. *Br J Health Psychol* 2012; 17:202–219.
- Rahmawati R, Bajorek B. Factors affecting self-reported medication adherence and hypertension knowledge: a cross-sectional study in rural villages, Yogyakarta Province, Indonesia. *Chronic Illn* 2018; 14:212–227.
- Sarkar A, Makwana NR, Pithadia P, Parmar DV. Compliance to antihypertensive therapy and its predictors: a cross-sectional study in western coastal region of India. *J Clin Diagn Res* 2018; 12:LC26–LC30.
- Da Silva Barreto M, Oliveira Reiners AA, Marcon SS. Knowledge about hypertension and factors associated with the nonadherence to drug therapy. *Revista Latino-Americana de Enfermagem* 2014; 22:491–498.
- Tan CS, Hassali MAA, Neoh CF, Ming LC. Beliefs about medicine and medication adherence among hypertensive patients in the community setting. *Drugs Ther Perspect* 2020; 36:358–367.
- Turner BJ, Hollenbeak C, Weiner MG, Ten Have T, Roberts C. Barriers to adherence and hypertension control in a racially diverse representative sample of elderly primary care patients. *Pharmacoepidemiol Drug Safety* 2009; 18:672–681.
- Wang PS, Bohn RL, Knight E, Glynn RJ, Mogun H, Avorn J. Noncompliance with antihypertensive medications: the impact of depressive symptoms and psychosocial factors. *J Gen Intern Med* 2002; 17:504–511.
- Yue Z, Bin W, Weilin Q, Aifang Y. Effect of medication adherence on blood pressure control and risk factors for antihypertensive medication adherence. *J Eval Clin Pract* 2015; 21:166–172.

37. Zhang Y, Li X, Mao L, Zhang M, Li K, Zheng Y, *et al*. Factors affecting medication adherence in community-managed patients with hypertension based on the principal component analysis: evidence from Xinjiang, China. *Patient Prefer Adherence* 2018; 12:803–812.
38. Horne R, Chapman S, Parham R, Freemantle N, Forbes A, Cooper F. Understanding patients' adherence-related beliefs about medicines prescribed for long-term conditions: a meta-analytic review of the Necessity-Concerns Framework. *PLoS One* 2013; 8:e80633.
39. Garfield S, Begum A, Toh KL, Lawrence-Jones A, Staley K, Franklin BD. Do patients and family carers have different concerns about the use of medicines compared with healthcare professionals? A quantitative secondary analysis of healthcare concerns relating to adults with complex needs. *Patient Educ Couns* 2021; 16:: S0738-3991(21)00349-9. doi: 10.1016/j.pec.2021.05.020 [Epub ahead of print].
40. Clifford S, Garfield S, Eliasson L, Barber N. Medication adherence and community pharmacy: a review of education, policy and research in England. *Pharm Pract* 2010; 8:77–88.