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Rozprawa doktorska

Planowanie indywidualne, diadyczne i kolaboracyjne: psychologiczne mechanizmy różnych typów planowania i wpływ na zachowania zdrowotne w diadach

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Spis treści

Abstrakt

Niniejsza rozprawa doktorska obejmuje cykl publikacji naukowych, które opierają się na wspólnym podłożu teoretycznym dotyczącym planowania indywidualnego („Mój plan dla mnie"), diadycznego („Wspólny plan dla mnie") oraz kolaboracyjnego („Wspólny plan dla nas"). Badania te miały na celu wyjaśnić efekty trzech form planowania na: (Badanie 1) zmianę poziomu umiarkowanej do intensywnej aktywności fizycznej (MVPA), (Badanie 2) mechanizmy mediujące procesy zmiany zachowań zdrowotnych (nawyk aktywności fizycznej, deklarowanego planowania indywidualnego i kolaboracyjnego oraz kolaboracyjnej kontroli społecznej), (Badanie 3) zmianę innych zmiennych wynikowych związanych ze zdrowiem (dieta, tkanka tłuszczowa).

W badaniach wykorzystano części większego badania (nr prerejestracji NCT03011385) przeprowadzonego w schemacie randomizowanego badania z grupą kontrolną. W badaniach uczestniczyło $N = 320$ diad (640 osób), składających się z osób docelowych (głównych odbiorców interwencji eksperymentalnej) oraz ich partnerów. Diady zostały przydzielone losowo do jednego z czterech warunków badawczych: planowanie kolaboracyjne ($n = 79$), planowanie diadyczne ($n = 83$), planowanie indywidualne ($n = 82$), grupa kontrolna ($n = 76$). Procedura obejmowała pomiary samoopisowe, akcelerometryczny pomiar MVPA oraz pomiar procentowej ilości tkanki tłuszczowej, rozłożone na przestrzeni 8 miesięcy z 1- i 36- tygodniowymi pomiarami follow-up (odpowiednio T1 oraz T4; Badanie 1), 9-tygodniowym pomiarem follow-up (T3; Badanie 2) oraz 36-tygodniowym pomiarem follow-up (T4; Badanie 3).

Wyniki Badania 1 wykazały, iż zarówno osoby docelowe jak i ich partnerzy z warunku planowania diadycznego uzyskali wzrost MVPA w 36 tygodniu obserwacji (T0-T4). Badanie 2 ukazało, iż w 9 tygodniu obserwacji (T0-T3), osoby docelowe w warunku planowania indywidualnego uzyskały wzrost nawyku aktywności fizycznej, badani z warunku planowania diadycznego zadeklarowali wzrost planowania kolaboracyjnego oraz kolaboracyjnej kontroli społecznej, natomiast uczestnicy z warunku planowania kolaboracyjnego uzyskali wzrost wszystkich wskaźników badanych mechanizmów pośredniczących (nawyku, planowania indywidualnego i kolaboracyjnego, a także kolaboracyjnej kontroli społecznej). Wyniki Badania 3 ukazały, iż w 36 tygodniu obserwacji (T0-T4) partnerzy przyporządkowani do warunku planowania (połączonego w jeden wspólny warunek badawczy), a także partnerzy w warunku planowania diadycznego, zredukowali procentową ilość tkanki tłuszczowej. Wśród osób docelowych nie stwierdzono zmian w poziomie tkanki tłuszczowej. Wszystkie osoby zredukowały spożywanie produktów wysokokalorycznych, niezależnie od warunku badawczego.

Badania pozwalają uzyskać odpowiedzi na pytania o to, który plan działa, jak planowanie działa oraz jakie jeszcze zmiany możemy wywołać po zastosowaniu planowania aktywności fizycznej. Poczynione obserwacje ukazują skuteczność planowania diadycznego.

Słowa kluczowe: aktywność fizyczna, planowanie, nawyk, procesy wymiany społecznej, tkanka tłuszczowa, dieta wysokoenergetyczna, randomizowane badanie eksperymentalne, diady

Abstract

This dissertation reports results of three studies that share a common theoretical background and refer to the effects of three types of planning: individual planning ("I plan for me"), dyadic planning ("We plan for me"), and collaborative planning ("We plan for us"). The studies aimed to explore the effects of the planning interventions on: (Study 1) the level of moderate-to-vigorous physical activity (MVPA), (Study 2) underlying psychosocial mechanisms of behavior change (physical activity habit, individual and collaborative planning, and collaborative social control), (Study 3) changes in health behaviors and health indicators other than those included in the planning (such as diet, body fat).

To achieve these objectives, data from a larger project (preregistration no. NCT03011385) were used. Participants were *N* = 320 dyads of target persons (the main recipient of the intervention) and their partners (a total *N* of 640). Dyads were randomly assigned to one research condition: the collaborative planning intervention (*n* = 79), the dyadic planning intervention (*n* = 83), the individual planning intervention (*n* = 82), or the active control condition (*n* = 76). Self-reported data, accelerometer-based MVPA, and percentage of body fat were measured across 8 months, with a 1- and 36-week follow-ups (respectively T1 and T4; Study 1), a 9-week follow-up (T3; Study 2) and a 36-week follow-up (T4; Study 1).

Results of Study 1 showed that target persons and partners in the dyadic planning condition increased their MVPA up to a 36-week follow-up (T0-T4). Results from Study 2 showed that participants in the individual planning condition increased their physical activity habits, participants in the dyadic planning condition increased self-reported collaborative planning and collaborative social control, and participants in the collaborative planning condition increased all tested indicators up to a 9-week follow-up (T0-T3). Regarding results from Study 3 partners in the planning condition (all planning conditions combined into one condition) and, in particular in the dyadic planning condition, decreased their percentage of body fat up to a 36-week follow-up (T0-T4), although target persons didn't change their body fat. Participants from all conditions reduced energy-dense food intake up to a 36-week follow-up (T0-T4).

In sum, Studies 1-3 provide novel evidence informing *if/which* plan has worked, *how* the three types of planning have worked, and *what other changes* in behavioral and health outcomes were triggered by a physical activity planning intervention. Findings showed that the dyadic planning condition was the most effective planning strategy.

Keywords: physical activity, planning, habit, social exchange processes, body fat, energy-dense food, randomized controlled trial, dyads

Wprowadzenie

Regularna Aktywność Fizyczna a Zdrowie

Regularna aktywność fizyczna jest zalecana niezależnie od wieku czy stanu zdrowia. W Polsce przyjmuje się rekomendacje dotyczące poziomu oraz ilości aktywności fizycznej zaproponowane przez Światową Organizację Zdrowia (WHO, 2022a). Według zaleceń, osoby dorosłe powinny cotygodniowo wykonywać: od 150 do 300 minut umiarkowaną aktywność fizyczną, od 75 do 150 minut aktywność intensywną lub ich odpowiednią kombinację (MVPA; WHO, 2022a). Zgodnie z rekomendacjami, nawet mniejsze dawki ruchu przynoszą korzyści zdrowotne, szczególnie wśród pacjentów z diagnozą choroby przewlekłej oraz w grupach ryzyka zachorowania (Warburton i in., 2016; WHO, 2022a). Niemniej, z międzynarodowych badań wynika, iż globalnie 1 na 4 dorosłych nie jest wystarczająco aktywny fizycznie (WHO, 2022a). Choć w ostatnich latach odnotowuje się wzrost kampanii oraz oddziaływań zwiększających świadomość społeczną w obszarze aktywności fizycznej (WHO, 2022b), to wciąż brakuje działań wspierających nawyki regularnego ruchu, które przyczyniłby się do wzrostu aktywności fizycznej społeczeństwa oraz brania odpowiedzialności za własne zdrowie (np. raport aktywności fizycznej Polaków wg. WHO, 2021).

Aktywność fizyczna jest zachowaniem, które ma korzystny wpływ na wiele aspektów zdrowotnych, między innymi sprzyja lepszej kondycji psychicznej chroniąc przed pojawieniem się depresji (Chekroud i in., 2018; Schuch i in., 2018), sprzyja poprawie funkcji poznawczych oraz polepszeniu samopoczucia (Mandolesi i in., 2018). Stanowi także skuteczny element leczenia i rehabilitacji pacjentów z diagnozą m.in., depresji, zaburzeń lękowych, jest też wykorzystywana w walce z przewlekłym stresem (Aylett i in., 2018; Pedersen i Saltin, 2015). Regularna aktywność fizyczna przyczynia się również do utrzymania i poprawy zdrowia fizycznego (Pedersen i Saltin, 2015; Warburton i in., 2006; Warburton i in., 2016). Co ważne, stanowi czynnik chroniący przed pojawieniem się tzw. „chorób niezakaźnych", doprowadzających do przedwczesnych zgonów (Katzmarzyk i in., 2022; WHO, 2022a).

Aktywność fizyczna to również jedno z zachowań zdrowotnych kluczowych w redukcji nadmiernej wagi (Pedersen i Saltin, 2015). Wraz ze wzrostem intensywności aktywności fizycznej wzrasta wydatek energetyczny organizmu przez co ruch może przyczyniać się do redukcji procentowego udziału tkanki tłuszczowej (Wewege i in., 2017, 2022). Aktywność fizyczna powinna zostać uznana za podstawowy element terapii w przypadku wielu problemów zdrowotnych oraz powinna być stosowana jako część standardowej profilaktyki w celu zapobiegania problemom zdrowotnym.

Poszukiwanie skutecznych metod, które zwiększyłyby szanse na podejmowanie regularnej aktywności fizycznej jest wyzwaniem priorytetowym. Celem specjalistycznych oddziaływań wspierających proces zmiany zachowań zdrowotnych powinno być tworzenie interwencji, które pomogą podjąć regularną aktywność fizyczną. Interwencje powinny zostać skierowane szczególnie do osób, które potrzebują zmiany, np. osób otyłych, chorujących przewlekle np. na choroby układu krążenia (ChuK) lub cukrzycę typu 2 oraz do tych, którzy znajdują się w grupie ryzyka wystąpienia problemów zdrowotnych, czyli osób nie spełniających rekomendacji WHO dla aktywności fizycznej (WHO, 2022a).

Planowanie Aktywności Fizycznej Jako Technika Zmiany Zachowań Zdrowotnych

Najnowsze badania (Rhodes i in., 2022) uznają, iż intencja, rozumiana jako zamiar zmiany, jest ważnym elementem procesu zmiany zachowania. Niemniej, intencja stanowi stosunkowo słaby determinant aktywności fizycznej (Rhodes i Dickau, 2012). Wzrost poziomu intencji przy słabym wzroście zmiany zachowania, jest określany jako zjawisko dystansu między intencją a zachowaniem („intention—behavior gap"; Webb i Sheeran, 2006).

Na decyzję osoby wykazującej intencję inicjowania aktywności fizycznej o przełożeniu tejże intencji na zachowanie ma wpływ, między innymi, proces planowania (Rhodes i in., 2022).

Modele postintencjonalne, takie jak model implementacji intencji (Gollwitzer, 1999) czy procesualne podejście do zmiany zachowań zdrowotnych (model HAPA; Schwarzer i Luszczynska, 2015) wyjaśniają, iż zainicjowanie zmiany zachowania można uzyskać przez wzmocnienie strategii samoregulacyjnych np. planując zmianę. Planowanie to sformułowanie mentalnej reprezentacji przyszłego działania, a konkretnie tego „kiedy", „gdzie" i „jak" działać, a nie tylko ustalenie tego, co zmieniać (Gollwitzer, 1999). Autorzy modelu HAPA (Schwarzer i Luszczynska, 2015) sugerują, iż zmianę należy rozumieć jako proces, w trakcie którego osoba możne znajdować się w jakościowo różnych stadiach zmiany (Schwarzer i Luszczynska, 2015; Zhang i in., 2019). Intencja stanowi efekt procesów motywacyjnych operujących w fazie preintencjonalnej. Kolejnym etapem zmiany zachowania jest jego zainicjowanie, co wyznacza przejście do fazy postintencjonalnej. Następnym krokiem zmiany będzie utrzymanie zachowania, które jest możliwe m.in. poprzez aktualizowanie planowania (Hagger i Luszczynska, 2014) oraz planowanie radzenia sobie z przeszkodami (Sniehotta i in., 2006). Intencja zmiany jest więc elementem początkowym procesu zmiany, ale nie wystarczającym do jego wdrożenia oraz utrzymania.

Według przytoczonych modeli teoretycznych plan stanowi kluczowy element samoregulacji zachowania w celu jego wdrożenia i oznacza konkretną, indywidualną mentalną reprezentację przyszłych okoliczności („kiedy", „gdzie") i przebiegu („jak") zachowania (Gollwitzer, 1999; Hagger i Luszczynska, 2014). Planując osoba identyfikuje odpowiednie i możliwe momenty do wprowadzenia zachowania, czyli sytuacje, w których ma ono nastąpić oraz podejmuje decyzję kiedy zadziałać. Planowanie jest więc tworzeniem nowych asocjacji między bodźcem (np. miejsce) a reakcją (np. specyficzna aktywność fizyczna o określonej intensywności). W ten sposób formułowanie planu tworzy okazję do organizacji działania oraz daje możliwość do włączenia zachowania w codzienne rutynowe czynności (Keller i in., 2017). Własne planowanie działań (tzw. planowanie indywidualne, „Mój plan dla mnie”) jest wskazane w taksonomii technik zmiany zachowań (Michie i in., 2013) jako technika zmiany zachowania o dużym potencjale do efektywnego wzbudzania zmian zachowań zdrowotnych.

Istniejące dowody naukowe potwierdzają, iż planowanie indywidualne ma mały lub umiarkowany wpływ na wzrost aktywności fizycznej jednostki (Belanger-Gravel i in., 2013; Carraro i Gaudreau, 2013; Hagger i Luszczynska, 2014; Peng i in., 2022). Poszerzenie perspektywy indywidualnego planowania o czynnik interakcji społecznych jest nowym kierunkiem psychologicznego oddziaływania na zmianę zachowań zdrowotnych.

Planowanie Indywidualne, Diadyczne i Kolaboracyjne w Kontekście Aktywności Fizycznej

Podstawową i najprostszą formą planowania jest plan indywidualny rozumiany jako własny plan („Mój plan dla mnie”) dotyczący tego „kiedy”, „gdzie” i „jak” osoba będzie aktywna fizycznie (Hagger i Luszczynska, 2014). Planowanie indywidualne pomija jednak fakt, że zmiana zachowania występuje w złożonych sytuacjach społecznych, nie uwzględnia więc kontekstu społecznego w jakim zwykle zachodzi zmiana zachowania (Rhodes i in., 2020; Rothman i in., 2020). Zaangażowanie dwóch osób w proces planowania poszerzyło formę planowania indywidualnego o nowe ujęcia oddziaływań psychologicznych, takie jak planowanie diadyczne (Knoll i in., 2017) i kolaboracyjne (Prestwich i in., 2012).

Planowanie diadyczne, tzw. „Wspólny plan dla mnie”, powstało w odpowiedzi na potrzebę wsparcia zmiany zachowania pacjentów (osób docelowych, czyli głównych odbiorców interwencji planowania) przez ich partnerów (osobę będącą w bliskiej w relacji np., romantycznej, przyjacielskiej, rodzinnej; Burkert i in., 2011). W planowaniu diadycznym osoba docelowa wraz ze wsparciem partnera formułuje plan „kiedy”, „gdzie”, „jak” będzie aktywna fizycznie (Burkert i in., 2011). Rolą partnera jest asystowanie przy planowaniu oraz wsparcie procesu tworzenia planu.

Bardziej złożoną formą planowania jest plan kolaboracyjny, tzw. „Wspólny plan dla nas” (Prestwich i in., 2012). W planowaniu kolaboracyjnym osoba docelowa wraz z partnerem wspólnie formułują plan dla wspólnej aktywności („kiedy”, „gdzie”, „jak” będziemy razem aktywni fizycznie; Prestwich i in., 2012).

Wcześniejsze badania przedstawiają mieszane wnioski dla zmian aktywności fizycznej po zastosowaniu planowania diadycznego czy kolaboracyjnego (np. Knoll i in., 2017; Prestwich i in., 2012). Na przykład, Prestwich i in. (2012) wykazali, iż po 6 miesiącach od interwencji, osoby w grupie planowania kolaboracyjnego deklarowały wzrost czasu spędzanego na aktywności fizycznej, w porównaniu do osób w grupie planowania indywidualnego oraz grupy kontrolnej. Wooldridge i in. (2019) odnotowali, iż w grupie planowania kolaboracyjnego, w porównaniu do grupy planowania indywidualnego, nie uzyskano przyrostu umiarkowanej do intensywnej aktywności fizycznej mierzonej obiektywnie po 6 miesiącach obserwacji, natomiast w grupie planowania kolaboracyjnego nastąpił wzrost deklarowanej aktywności fizycznej. Knoll i in. (2017) po 6 tygodniach obserwacji zmian umiarkowanej i intensywnej aktywności fizycznej mierzonej za pomocą akcelerometrii, nie uzyskali różnic pomiędzy osobami docelowymi w grupie planowania diadycznego a grupą planowania indywidualnego, czy grupą kontrolną. Partnerzy z grupy planowania diadycznego początkowo uzyskali wzrost intensywnej aktywności fizycznej, który nie utrzymał się w dłuższym czasie (Knoll i in., 2017).

Istniejące badania przynoszą niejednoznaczne wnioski, co może być efektem stosowania odmiennych procedur badawczych (Luszczynska, 2020). Poszczególne formy planowania różnią się pod względem procedury planowania oraz jej złożoności (asystowanie versus kooperacja przy planowaniu zachowania). Jak dotąd brakuje również badań porównujących wszystkie trzy formy planowania jednocześnie oraz badań odwołujących się do zmian u obu parterów. Role, które przyjmują osoby w diadzie podczas formułowania planów (osoba docelowa oraz partner, inaczej mówiąc wspierany i wspierający) wyznaczają specyficzne zadania, jakie stają przed każdą z osób uczestniczących w procesie planowania. Można więc założyć, iż przyjęte role, a szczególnie odmienne role w planowaniu diadycznym, mogą mieć kluczowe znaczenie dla wzrostu MVPA (intensywności rekomendowanej przez WHO, 2022a).

Planowanie Aktywności Fizycznej w Diadzie

Diada jest rozumiana jako dwie bliskie sobie osoby, tworzące system regulacyjny, w którym obie osoby mogą na siebie oddziaływać podczas stawiania i realizacji celów (Berli i in., 2018). Mogą to być partnerzy romantyczni, ale także przyjaciele, dobrzy znajomi lub rodzina (Carr i in., 2019). Włączenie bliskich osób w proces zmiany zachowań zdrowotnych pozwoliło na uwzględnienie w nim procesów społecznych i tym samym lepsze oddanie kontekstu zmiany (Rhodes i in., 2020). Wiadomo również, że osoby będące w bliskiej relacji podejmują podobne zachowania, m.in. takie jak aktywność fizyczna (Pauly i in., 2019). Partnerzy diadyczni mają istotne znaczenie dla zmiany zachowań zdrowotnych swoich bliskich w kontekście aktywności fizycznej (Arden-Close i McGrath, 2017; Berli i in, 2018; Carr i in., 2019; Cook i Kenny, 2005). Istnieją dowody naukowe potwierdzające, iż interwencje psychospołeczne, które są skierowane na diady, a nie jednostki są skuteczniejsze (Carr i in., 2019), gdyż uwzględniają naturalny kontekst zmiany zachowań (Helgeson i in., 2018).

Aktywne włączenie partnera w proces zmiany zachowania jest spójne z modelem wspólnego radzenia sobie z chorobą (communal coping approach; Helgeson i in., 2018). Samo zaangażowanie się w proces zmiany sprzyja zmianom u osoby chorej, a także jej partnera/partnerki diadycznej (Berli i in., 2018). Planowanie diadyczne oraz kolaboracyjne stwarza warunki, które z powodzeniem mogą być wykorzystywane wśród diad bliskich osób; obie formy planowania zakładają aktywną rolę partnera w procesie zmiany. Z drugiej strony badania nad planowaniem diadycznym oraz kolaboracyjnym przyniosły niejednoznaczne konkluzje na temat efektywności tych procedur dla zmian aktywności fizycznej (np. Knoll i in., 2017; Prestwich i in., 2012). Niestety, jedynie nieliczne badania wykorzystujące technikę planowania badają proces zmiany również u partnerów.

Biorąc pod uwagę, iż zmiana zachowań zdrowotnych występuje w kontekście społecznym, to współudział bliskich osób w procesie planowania i tym samym tworzenie badań z udziałem diad bliskich sobie osób, może mieć znaczenie dla zmian tychże zachowań i zdrowia u obu partnerów. Tym samym szczególnej wartości może nabierać rola planowania diadycznego i kolaboracyjnego w schemacie badań diadycznych.

Zrozumienie Mechanizmu Planowania Aktywności Fizycznej

Zgodnie z modelami procesów dualnych (Hagger i Hamilton, 2020; Strack i Deutsch, 2004), planowanie indywidualne może uaktywniać dwa procesy: (1) automatyczne/ nawykowe, czyli bezrefleksyjne oraz (2) przemyślane, czyli świadome podejmowanie decyzji i samoregulacji. Hipoteza automatyzacji zachowania zakłada, iż plan tworzy warunki do silnego połączenia między sytuacją (bodziec) a reakcją behawioralną, tym samym ułatwia inicjację zachowania, gdy pojawi się antycypowany bodziec (Bieleke i in., 2021; Gardner i in., 2012; Gardner i Lally, 2018). Badania wskazują, że indywidualne planowanie aktywności fizycznej jest predyktorem siły nawyku (Schwarzer i in., 2018).

Alternatywna hipoteza wyjaśnia, iż planowanie indywidualne wymaga świadomych i przemyślanych procesów decyzyjnych (Hagger i Luszczynska, 2014; Prestwich i in., 2015). Skutkuje to regularnym korzystaniem z techniki planowania w celu wprowadzania zmian w złożonych zachowaniach, m.in. aktywności fizycznej (Keller i in., 2021; Luszczynska i in., 2016). Poprzez stosowanie interwencji planowania indywidualnego, ale również diadycznego, można uzyskać krótkotrwały wzrost wykorzystania tych form planowania w kontekście aktywności fizycznej (Burkert i in., 2011; Keller i in., 2020). Brakuje badań wyjaśniających mechanizmy planowania kolaboracyjnego.

Zgodnie z modelami diadycznych interakcji w kontekstach zdrowotnych (systemowy model transakcyjny, Bodenmann, 1997; model kongruencji, Revenson, 1994; model skoncentrowany na relacji, O'Brien i DeLongis, 1996), zaangażowanie partnera w zmianę zachowania zdrowotnego może aktywować procesy społeczne. Włączenie bliskich osób w proces planowania może również pozwolić na lepsze rozumienie mechanizmu zmiany zachowania (Rhodes i in., 2020; Scholz i in., 2020). Istnieją liczne dowody naukowe potwierdzające, iż planowanie diadyczne i kolaboracyjne może aktywować procesy wpływu społecznego, jak np. wsparcie społeczne lub kontrolę społeczną (Keller i in., 2020; Knoll i in., 2017; Prestwich i in., 2012, 2014). Jednym z wyznaczników procesów społecznych, który jak dotąd nie był weryfikowany w kontekście planowania aktywności fizycznej, jest kolaboracyjna kontrola społeczna. Kolaboracyjna kontrola społeczna, jest rozumiana jako oferowanie współuczestnictwa w aktywności fizycznej i pomaganie osobie badanej w nauce umiejętności ważnych dla danych aktywności (Wilson i Spink, 2010) w celu wywołania zachowania.

Chociaż badania potwierdzają, iż różne formy planowania wiążą się z aktywacją procesów nawykowych, samoregulacyjnych lub społecznych (np. Keller i in., 2020; Knoll i in., 2017; Prestwich i in., 2012, 2014; Verplanken i Orbel, 2019), to wciąż brakuje odpowiedzi na pewne kwestie. Większość badań odnosi się do wyjaśniania mechanizmów planowania indywidualnego oraz planowania diadycznego; mechanizmy planowania kolaboracyjnego są niejasne. Dodatkowo, planowanie diadyczne oraz kolaboracyjne uwzględnia aktywną rolę partnera podczas formułowania planów, jednakże oprócz odmiennych ról, jakie przyjmują osoby w diadach, nie ma przesłanek pozwalających stwierdzić co różnicuje obie formy planowania. Ostatecznie, każda z trzech form planowania różni się pod względem złożoności formy planowania. Złożoność planowania może mieć znaczenie dla rodzajów oraz ilości aktywowanych procesów, np., planowanie kolaboracyjne angażujące oboje partnerów zarówno w proces planowania, jak i zmianę zachowania, można więc założyć, iż wymagać będzie aktywacji większej liczby zasobów obecnych m.in. w świadomych procesach samoregulacji, jak i procesach społecznych.

Planowanie Aktywności Fizycznej a Oddziaływanie na Inne Zachowania Zdrowotne oraz Zdrowie

Badania ukazują, iż interwencje psychologiczne mogą skutkować:

(1) korzystnym efektem ubocznym (*spillover effect;* Geller i in., 2017) zakładającym, iż podczas wprowadzania zmiany aktywności fizycznej osoby nabywają umiejętności samoregulacyjnych, które następnie mogą wykorzystać dla zmian w diecie (Hagger i in., 2010; Halliday i in., 2014; Mata i in., 2009);

(2) efektem kompensacyjnym (*compensatory effect;* Geller i in., 2017), ponieważ wykorzystanie zasobów regulacyjnych dla jednego zachowania może skutkować wyczerpaniem zasobów regulacyjnych potrzebnych dla wdrożenia zmiany innego zachowania (Hagger i in., 2010). Według modelu kompensacyjnych przekonań zdrowotnych zaangażowanie się w zmianę jednego zachowania zdrowotnego może być również kompensowane przez zaangażowanie w inne zachowanie, tym razem niekorzystne dla zdrowia (jeśli dziś biegam, mogę zjeść 2 pączki; Radtke i in., 2012);

(3) efektem transferu (*ripple effect;* Gorin i in., 2008), gdyż zgodnie z diadycznymi modelami zmiany zachowań zdrowotnych, relacja, przekonania i zachowania jednego członka diady wpływają na przekonania i zachowania drugiego członka (Huelsnitz i in., 2022; Pietromonaco i in., 2013), a tym samym wspierają wystąpienie zmian nie tylko wśród docelowych odbiorców interwencji, ale również w grupie ich partnerów.

Istnieją silne dowody naukowe ukazujące, iż wprowadzenie regularnej aktywności fizycznej może sprzyjać redukcji tkanki tłuszczowej (np. Wewege i in., 2022). Interwencje skoncentrowane na wprowadzaniu sesji treningu fizycznego w różnym stopniu potwierdzają wystąpienie zmian w odżywianiu. Na przykład, po sesji treningów oporowych trwających 12 tygodni badani zredukowali spożywanie produktów wysokoenergetycznych (Halliday i in., 2014), ale po zakończeniu sesji treningowych zmiany w odżywianiu nie zostały utrzymane w dłuższym odstępie czasu (Halliday i in., 2017). Dutton i in. (2008) również odnotowali redukcję spożycia tłuszczy po wprowadzeniu interwencji ze zorganizowaną aktywnością fizyczną, a Fleig i in. (2011) ukazali, że po 6 tygodniach po włączeniu interwencji wspierających samoregulację (w tym planowania aktywności fizycznej), można uzyskać wzrost spożycia warzyw i owoców.

Dotychczasowe badania koncentrowały się głównie na występowaniu efektu kompensacyjnego oraz korzystnego efektu ubocznego w kontekście interwencji których celem było wprowadzanie sesji treningu aktywności fizycznej (np., Dutton i in., 2008; Halliday i in., 2014), a nie rozwijanie kompetencji samoregulacyjnych (za wyjątkiem Fleig i in., 2011). Brakuje badań, które weryfikują wpływ interwencji planowania aktywności fizycznej na zmiany zachowań innych niż te, do których bezpośrednio odnosi się dane planowanie, czy też wpływ interwencji planowania aktywności fizycznej na zmiany wyznaczników zdrowia, takich jak procentowy udziału tkanki tłuszczowej. Weryfikacji wymaga również to, czy zmiany mogą powstać wśród partnerów wspomagających osoby docelowe podczas planowania zmiany.

Główne Cele Badań Własnych

Głównym celem niniejszej rozprawy doktorskiej jest testowanie efektów trzech form planowania aktywności fizycznej (planowanie indywidualne, diadyczne i kolaboracyjne) na zachowanie zdrowotne, jakim jest aktywność fizyczna, lepsze poznanie mechanizmów planowania aktywności fizycznej oraz weryfikacja możliwości uzyskania dodatkowych zmian w zachowaniu i zdrowiu po zastosowaniu planowania aktywności fizycznej.

Pytania Badawcze Badań Własnych

Cykl badań ma za zadanie odpowiedzieć na następujące pytania badawcze:

1) Badanie 1: **który plan spowoduje wzrost umiarkowanej do intensywnej aktywności fizycznej (moderate-to-vigorous physical activity; MVPA)?**

2) Badanie 2: **jak planowanie aktywności fizycznej działa**, czyli **wyjaśnienie mechanizmów planowania, czy są nimi procesy automatyczne/nawykowe, świadome procesy samoregulacji lub procesy społeczne, a może kombinacja poszczególnych procesów?**

3) Badanie 3: **co jeszcze zmienia planowanie aktywności fizycznej,** czyli **jakie dodatkowe zmiany zachowania oraz korzyści dla zdrowia możemy uzyskać po zastosowaniu planowania aktywności fizycznej?**

Zaproponowane porównanie trzech form planowania aktywności fizycznej ma za zadanie (1) ustalić, która forma planowania będzie wpływać na zmiany aktywności fizycznej, (2) pozwolić na lepsze rozumienie jaki mechanizm psychologiczny odpowiada za proces zmiany zachowania w przypadku gdy wykorzystujemy daną formę planowania, (3) ustalić czy można uzyskać dodatkowe korzyści zdrowotne i zmiany zachowań po zastosowaniu planowania aktywności fizycznej.

Wspólna Procedura Badawcza

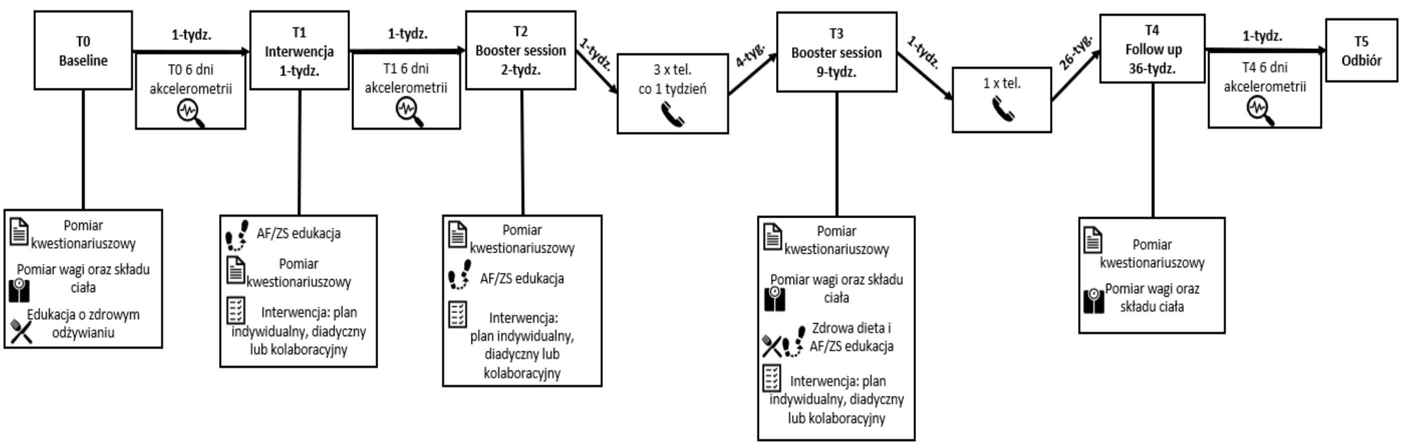
Dla celów rozprawy doktorskiej wykorzystane zostały elementy z większej procedury badawczej (Rycina 1) prejerestrowane w repozytorium Clinical Trials, nr prerejestracji NCT03011385, uwzględniającej randomizowane badanie z grupą kontrolną. Badanie zostało zatwierdzone przez Komisję ds. Etyki Badań Naukowych SWPS Uniwersytetu Humanistycznospołecznego.

Wspólnym elementem dla cyklu 3 publikacji naukowych jest procedura badawcza (Rycina 1), w której wzięło udział *N* = 320 diad składających się z osób docelowych i ich partnerów. Osoba docelowa, czyli główny odbiorca interwencji, to osoba spełniająca warunki włączenia, czyli: deklarująca < 150 min umiarkowanej do intensywnej aktywności fizycznej (MVPA) tygodniowo i/lub chorobę przewlekłą np. choroby układu krążenia (ChuK) lub cukrzycę typu 2, intencję aktywności fizycznej, będąca w bliskiej relacji romantycznej, przyjacielskiej lub rodzinnej z partnerem, z którym tworzy diadę. Diady były losowo przydzielane do następujących warunków badawczych: planowanie kolaboracyjne (*n* = 79), planowanie diadyczne (*n* = 83), planowanie indywidualne (*n* = 82), grupa kontrolna (*n* = 76).

Badanie przeprowadzono w 32 miejscowościach (25 miastach, 7 rejonach wiejskich) w południowo-zachodniej, centralnej i północnej Polsce, w okresie od lutego 2016 r. do lutego 2020 r. Dane zostały zebrane przez przeszkolonych eksperymentatorów (szkolenie obejmowało udział w przynajmniej dwóch spotkaniach oraz regularną superwizję). Badania odbywały się w miejscach uzgodnionych z uczestnikami. Uczestnictwo w badaniu wiązało się z podpisaniem świadomej zgody oraz było gratyfikowane drobnym upominkiem (średnia wartość ok. 40 zł), wręczanym po każdym ze stacjonarnych spotkań.

Rycina 1

Plan Badawczy



Nota. T = punkt pomiaru; AF = aktywność fizyczna; ZS = zachowania siedzące.

Interwencja

W trakcie pomiaru T0 eksperymentator przeprowadzał pierwszą edukację na temat zaleceń dotyczących zdrowego odżywiania; podczas pomiaru T1, eksperymentator przeprowadzał pierwszą edukację na temat zaleceń dotyczących aktywności fizycznej i zachowań siedzących. Odpowiednia edukacja została powtórzona w celu wzmocnienia i utrwalenia wiedzy (T2, T3 oraz 4 rozmowy telefoniczne, patrz. Rycina 1). Edukacja była taka sama dla każdej diady. Dodatkowo (poza edukacją) osoby w grupie planowania uzyskały odpowiednią interwencję planowania indywidualnego, diadycznego lub kolaboracyjnego. Wszystkie trzy warunki planowania obejmowały odpowiednie techniki behawioralne takie jak planowanie działań, identyfikacja barier, wsparcie społeczne, zapobieganie nawrotom/planowanie radzenia sobie, dopasowane do poszczególnych form planowania (BCTs; Michie i in., 2013).

Grupa kontrolna

Osoby docelowe i partnerzy zostali poinformowani o zaleceniach dotyczących zdrowego odżywiania, aktywności fizycznej i zmiany zachowań siedzących, według procedury edukacji (T1, T2, T3, T4 oraz czterokrotny kontakt telefoniczny). Interwencja nie uwzględniała planowania.

Indywidualna Interwencja Planowania (T1, T2, T3 oraz cztery rozmowy telefoniczne)

Osoby docelowe i partnerzy zostali poproszeni o stworzenie indywidualnych planów aktywności fizycznej („Mój plan dla mnie”) na kolejne 7 dni. W przypadku każdego planu, diady zostały poproszone o nieomawianie i niewypełnianie wspólnie arkuszy. Planowanie obejmowało indywidualną decyzję osoby docelowej oraz partnera dotyczącą tego "kiedy", "gdzie" i "jak” wykonywać aktywność fizyczną samodzielnie (Luszczynska i in., 2007; zobacz także Knäuper i in., 2018). Następnie oboje partnerzy indywidualnie sprawdzali, czy mają czas na zaplanowaną aktywność fizyczną i czy planowana aktywność fizyczna jest dopasowana do ich potrzeb i możliwości. Dodatkowo indywidualnie stworzyli plany alternatywne deklarując jakie przeszkody mogły utrudnić realizację planu oraz jak poradziliby sobie z daną przeszkodą, tak aby po mimo utrudnień zaangażować się w zaplanowaną aktywność fizyczną (Sniehotta i in., 2006).

Diadyczna Interwencja Planowania (T1, T2, T3 oraz cztery rozmowy telefoniczne)

Osoby docelowe i partnerzy zostali poproszeni o wspólne opracowanie planów aktywności fizycznej dla osoby docelowej („Wspólny plan dla mnie”) na kolejne 7 dni. Rolą partnera było asystowanie przy tworzeniu planu przez osobę docelową. W odniesieniu do każdego planu, pary zostały więc poproszone o konsultowanie między sobą i wypełnienie arkusza w formacie: "kiedy", "gdzie" i "jak" osoba docelowa mogłaby uprawiać aktywność fizyczną (Knoll i in., 2017). Następnie osoby docelowe sprawdziły, czy mają czas na zaplanowaną aktywność fizyczną i czy zaplanowana aktywność fizyczna jest dopasowana do ich potrzeb i możliwości. Podobnie jak w planowaniu indywidualnym diady zostały poproszone o stworzenie planów alternatywnych, ale dopasowanych do warunku diadycznego (asystowanie partnera przy tworzeniu przez osoby docelowej planu alternatywnego).

Kolaboracyjna Interwencja Planowania (T1, T2, T3 oraz cztery rozmowy telefoniczne)

Osoby docelowe i partnerzy zostali poproszeni o opracowanie wspólnych planów aktywności fizycznej („Wspólny plan dla nas”) na kolejne 7 dni. Dla każdego planu poproszono pary o omówienie i wypełnienie arkusza w formacie: "kiedy", "gdzie" i "jak" partnerzy będą wspólnie podejmować aktywność fizyczną (Prestwich i in., 2012). Następnie oboje partnerzy sprawdzali, czy mają czas na zaplanowaną wspólną aktywność fizyczną i czy zaplanowana aktywność fizyczna jest dopasowana do ich możliwości i potrzeb. Podobnie jak w planowaniu diadycznym pary zostały poproszone o stworzenie planów alternatywnych, ale dopasowanych do warunku kolaboracyjnego (wspólne ustalanie przeszkód oraz sposobów poradzenia sobie z nimi).

Badanie 1

(por. Kulis, Szczuka, Keller i in., 2022)

Teoretyczne podstawy dla Badania 1 to przede wszystkim model implementacji intencji (Gollwitzer, 1999) oraz procesualne podejście do zmiany zachowań zdrowotnych (model HAPA; Schwarzer i Luszczynska, 2015). Badanie 1 jest odpowiedzią na brak jednoznacznych wniosków z badań nad skutecznością planów indywidualnych dla zwiększenia aktywności fizycznej mierzonej akcelerometrycznie (Belanger-Gravel i in., 2013; Carraro i Gaudreau, 2013; Hagger i Luszczynska, 2014) oraz zaobserwowane niejasności po zastosowaniu planów diadycznych oraz kolaboracyjnych (np. Knoll i in., 2017; Prestwich i in., 2012). Brakuje badań sprawdzających efekty wszystkich trzech form planowania jednocześnie na rekomendowaną aktywność fizyczną (WHO, 2022a) oraz dokonywania obserwacji zmian u obu partnerów diadycznych.

Cele (Badanie 1)

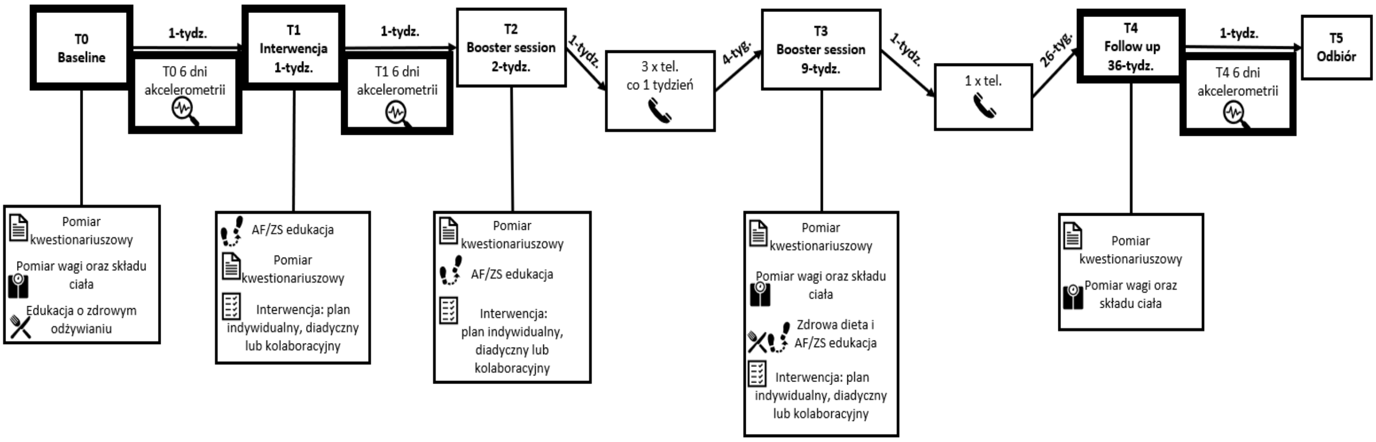
Szczegółowym celem Badania 1 było sprawdzenie czy planowanie indywidualne, diadyczne i kolaboracyjne przyczyni się do zmiany umiarkowanej do intensywnej aktywności fizycznej (MVPA), która jest rekomendowana przez WHO (WHO, 2022a). Zmiany MVPA osób w warunkach planowania porównywano ze zmianami w grupie kontrolnej (brak planowania). Zmiana była testowana u osób docelowych (główni odbiorcy interwencji) oraz ich partnerów (osoby pomocowe).

Metoda (Badanie 1)

W Badaniu 1 wykorzystano elementy większego badania zgodne z procedurą badawczą randomizowanego badania z grupą kontrolną, prerejestrowanego w repozytorium Clinical Trials, nr prerejestracji NCT03011385. Wykorzystane elementy procedury badawczej przedstawia Rycina 2. W Badaniu 1 wykorzystano dane osób docelowych oraz partnerów z punktów pomiarowych T0 (pomiar początkowy, przed interwencją dotyczącą planowania), T1 (tydzień po pomiarze początkowym oraz po wprowadzeniu interwencji eksperymentalnej), a także T4 (36 tygodni od pomiaru początkowego [T0], 6 miesięcy od ostatniej interwencji eksperymentalnej).

Rycina 2

Plan Badawczy Badania 1



Nota. T = punkt pomiaru; AF = aktywność fizyczna; ZS = zachowania siedzące. Pogrubione linie oznaczają wykorzystane w Badaniu 1 punkty pomiarowe.

Narzędzia

W Badaniu 1 wykorzystano następujące narzędzia pomiarowe:

Umiarkowana do Intensywnej Aktywność Fizyczna (MVPA) - Główna Zmienna Wynikowa. W pomiarach T0, T1 i T4 dokonano obiektywnego pomiaru umiarkowanej do intensywnej aktywności fizycznej (MVPA) za pomocą trójosiowej akcelerometrii (ActiGraph wGT3X). Pomiar MVPA wykonano zarówno u osób docelowych, jak i partnerów. Uczestnicy zostali poinstruowani, aby nosić akcelerometr na prawym biodrze od momentu przebudzenia przez 6 kolejnych dni przez co najmniej 14 godzin dziennie. Do analiz włączone zostały dane z minimum 3 dni, w czasie których urządzenie było noszone przez przynajmniej 8 godzin (tj. ważny dzień pomiarowy; Prescott i in., 2020).

Zmienne Kontrolowane. Za pomocą skal samoopisowych z pomiaru T0 weryfikowano płeć (1= mężczyzna, 0 = kobieta), wiek, indeks masy ciała (body mass index; BMI), edukację, status ekonomiczny, intencję aktywności fizycznej mierzoną dwoma pozycjami kwestionariuszowymi, np. *"Zamierzam zaangażować się w kilka 30-minutowych sesji umiarkowanej aktywności fizycznej w następnym tygodniu."* (Maher i Conroy, 2015) oraz typ relacji (1 = romantyczna relacja, 0 = inna).

Analizy Danych (Badanie 1)

Dane analizowano przy użyciu programu IBM SPSS 26. Braki danych (inne niż dane oparte na akcelerometrii) zostały uzupełnione za pomocą procedury *full information maximum likelihood*. Użyto liniowych modeli mieszanych do modelowania zmian MVPA u osób docelowych i partnerów z uwzględnieniem do 1 i 36 tygodnia czasu obserwacji (odpowiednio T0-T1 oraz T0-T4). W celu modelowania efektów Czasu, zmienna czas została zakodowana 0 = 0 tygodni (T0), 1 = 1 tydzień (T1), 36 = 36 tygodni (T4). Modele uwzględniały również analizę efektów interakcji Czasu x Warunku badawczego. Każda z grup eksperymentalnych została zakodowana dychotomicznie np. 1 = warunek planowania kolaboracyjnego, 0 = pozostałe warunki badawcze, we wszystkich głównych analizach grupa kontrolna stanowiła grupę odniesienia. We wszystkich głównych analizach kontrolowano płeć (1 = mężczyzna, 0 = kobieta) oraz wiek i BMI. W celu zbadania stabilności wyników przeprowadzono analizy wrażliwości z uwzględnieniem zmiennych: statusu ekonomicznego, wykształcenia, intencji aktywności fizycznej z T0 oraz typ związku (1 = romantyczny, 0 = inny). Dodatkowo przeprowadzono analizę moderacji w celu sprawdzenia interakcji Czas x Warunek x Typ relacji, a następnie zbadano wpływ interwencji eksperymentalnej na oddzielnie wskaźniki umiarkowanej aktywności fizycznej (MPA) i intensywnej aktywności fizycznej (VPA).

Wyniki (Badanie 1)

Efekt Planowania Kolaboracyjnego, Diadycznego i Indywidualnego na MVPA

Dla 1- tygodniowych obserwacji (T0-T1), wśród osób przyporządkowanych do warunku kolaboracyjnego, diadycznego i indywidualnego w porównaniu do grupy kontrolnej nie zaobserwowano istotnych zmian MVPA zarówno wśród osób docelowych, jak i u partnerów (porównaj artykuł nr 1 Kulis, Szczuka, Keller i in., 2022 Tabela 1 i 2).

Na przestrzeni 36 tygodni, u osób docelowych wystąpiła istotna interakcja Czas x Warunek (p = 0,045) dla osób w warunku planowania diadycznego (porównaj artykuł nr 1 Kulis, Szczuka, Keller i in., 2022 Tabela 1 i 2). Pomiędzy T0 a T4, osoby docelowe w warunku kontrolnym wykazały spadek MVPA (średnio) o -5,07 min/dzień, podczas gdy osoby docelowe w warunku planowania diadycznego wykazały wzrost MVPA o 5,07 min/dzień. Obserwowana zmiana MVPA jest powyżej progu minimalnej klinicznie istotnej różnicy.

Na przestrzeni 36 tygodni u partnerów wykazano istotną interakcję Czas x Warunek (p = 0,028) dla warunku planowania diadycznego (porównaj artykuł nr 1 Kulis, Szczuka, Keller i in., 2022 Tabela 1 i 2). Pomiędzy T0 a T4 partnerzy w warunku kontrolnym wykazali spadek MVPA (średnio) o -4,10 min/dzień, podczas gdy partnerzy w warunku planowania diadycznego wykazali wzrost MVPA o 1,29 min/dzień. Obserwowana zmiana MVPA jest powyżej progu minimalnej klinicznie istotnej różnicy.

Analizy wrażliwości modeli przeprowadzone dla osób docelowych oraz parterów, w których kontrolowano status ekonomiczny, wykształcenie, intencję aktywności fizycznej i rodzaj związku, wykazały podobne wyniki (porównaj artykuł nr 1 Kulis, Szczuka, Keller i in., 2022).

Dodatkowe Analizy: Efekt Rodzaju Relacji oraz Efekty Zmian MPA i VPA

Dodatkowe analizy dla zmian MVPA w T0-T1 lub T0-T4 wśród obu partnerów diadycznych wykazały brak istotnych efektów dla analiz interakcji Czas x Rodzaj Relacji oraz brak istotnych efektów interakcji Czas x Rodzaj Relacji x Warunek badawczy (porównaj artykuł nr 1 Kulis, Szczuka, Keller i in., 2022).

Wyniki dodatkowych analiz przeprowadzonych dla zmian w MPA i VPA ukazały istotne interakcje Czas x Warunek (porównaj artykuł nr 1 Kulis, Szczuka, Keller i in., 2022). W szczególności, osoby docelowe w warunku planowania diadycznego zwiększyły poziom MPA w T0-T1 i VPA w T0-T4 oraz partnerzy w warunku planowania diadycznego zwiększyli poziom MPA w T0-T4, wszystkie *p*s < 0,039.

Dyskusja Wyników (Badanie 1)

Niniejsze badanie jest pierwszym, w którym porównano planowanie kolaboracyjne, diadyczne i indywidualne w kontekście 1-tygodniowego i 36-tygodniowego obiektywnie mierzonego poziomu MVPA. Przeprowadzone analizy ukazały, iż w perspektywie 36 tygodni (ok. 6 miesięcy po ostatniej zastosowanej interwencji) planowanie diadyczne skutkuje wzrostem poziomu MVPA zarówno wśród osób docelowych jak i u partnerów. Osoby w warunku indywidualnym oraz kolaboracyjnym uzyskały podobny efekt zmiany MVPA co grupa kontrolna.

Uzyskane wyniki podkreślają znaczenie planowania diadycznego, podobnie jak wcześniejsze badania prowadzone w kontekście radzenia sobie przez pacjentów i partnerów z chorobą przewlekłą (Burkert i in., 2011). W planowaniu diadycznym, w przeciwieństwie do planowania indywidualnego i kolaboracyjnego, uwidacznia się podział na pełnione role: pacjent to osoba docelowa, na której skupiony zostaje proces zmiany, a partner to osoba asystująca, wspierająca. Dodatkowo planowanie diadyczne jest związane z procesami wpływu społecznego, takimi jak zapewnienie i otrzymanie wsparcia społecznego, kontrola społeczna, modelowanie, nagradzanie itp. (Berli i in., 2018; Burkert i in., 2011; Keller i in., 2020; Knoll i in., 2017). Sama obserwacja zmiany, czy aktywne uczestniczenie przez partnerów w procesie zmiany przekłada się na wystąpienie zmiany również w ich grupie (Berli i in., 2018). W badaniu własnym, w efekcie procedury planowania diadycznego nastąpiło przyjęcie ról przez partnerów diadycznych (potrzebujący zmiany versus pomagający w zmianie), które odpowiadały ich sytuacji życiowej (tj. osoby docelowe były osobami z chorobami przewlekłymi lub według obowiązujących standardów WHO – osobami wymagającymi zmiany w zakresie aktywności fizycznej, a partnerzy wpierali ich w zmianie zachowania), co przyczyniło się do wzrostu MVPA wśród obu partnerów.

W Badaniu 1 na uzyskane zmiany MVPA mogła mieć również wpływ procedura badawcza składająca się z powtórzonych interwencji planowania, zachęcania do samodzielnego stosowania planowania oraz nauki odpowiedniej formy planowania. Stosowanie aktywnych elementów interwencji dla procesu zmiany (Luszczynska, 2020) oraz sesji wzmacniających (np. powtarzanie procedury interwencyjnej; Chapman i Armitage, 2010; Scholz i in., 2013) jest uznawane jako istotny element interwencji skupionych na zmianie zachowania zdrowotnego.

Niniejsze wyniki mogą mieć szczególne znaczenie dla doboru interwencji, w których uczestniczą osoby, u których zaleca się podniesienie poziomu aktywności fizycznej oraz które deklarują choroby przewlekłe np. choroby układu krążenia i/lub cukrzycę typu 2. Co więcej uzyskany efekt wzrostu MVPA ujawnia się również wśród partnerów, przez co interwencja skupiona na osobie docelowej ma szersze oddziaływanie, bo wywołuje zmiany również u osoby współtowarzyszącej.

Badanie 2

(por. Kulis, Szczuka, Banik i in., 2022)

Badanie 2 odwołuje się do teoretycznych podejść wyjaśniających psychologiczne mechanizmy pośredniczące w procesie planowania aktywności fizycznej, w celu dążenia do osiągnięcia poziomu aktywności zgodnego z ogólnoświatowymi rekomendacjami (WHO, 2022a). W szczególności, odwołuje się do modeli procesów dualnych uwzgledniających procesy automatyczne/nawykowe oraz świadome procesy samoregulacji (Hagger i Hamilton, 2020; Strack i Deutsch, 2004). Zgodnie z modelem procesów dualnych, aktywacja poszczególnych procesów może zależeć od złożoności zadania jakie ma zostać wykonane, a bardziej wymagające zadania wymagają przemyślanych działań (Hagger, 2019). Dodatkowo, uwzględnienie partnera w procesie planowania, jak ma to miejsce przy planowaniu diadycznym i kolaboracyjnym, nie wyklucza oddziaływania procesów wpływu społecznego (np. Keller i in., 2020; Knoll i in., 2017; Prestwich i in., 2012, 2014), których wyznacznikiem może być również kolaboracyjna kontrola społeczna (Wilson i Spink, 2010). Złożoność zadania oraz współudział partnerów w procesie planowania mogą być kluczowymi determinantami aktywacji poszczególnych procesów zmiany.

Cele (Badanie 2)

Celem Badania 2 było wyjaśnienie jakie są mechanizmy trzech form planowania. Szczególnie, celem było wyjaśnienie, która z trzech form planowania (planowanie indywidualne, diadyczne i kolaboracyjne) spowoduje zmiany we wskaźnikach poszczególnych procesów pośredniczących w zmianie wśród osób docelowych (głównych odbiorców interwencji): nawyku aktywności fizycznej (rozumiany jako proces automatyczny/nawykowy), deklaracjach o stosowaniu planu indywidualnego oraz kolaboracyjnego (rozumiane jako świadome procesy samoregulacji, a w przypadku współpracy również jako proces wpływu społecznego) oraz kolaboracyjnej kontroli społecznej (uznanej jako wyznacznik procesu wpływu społecznego).

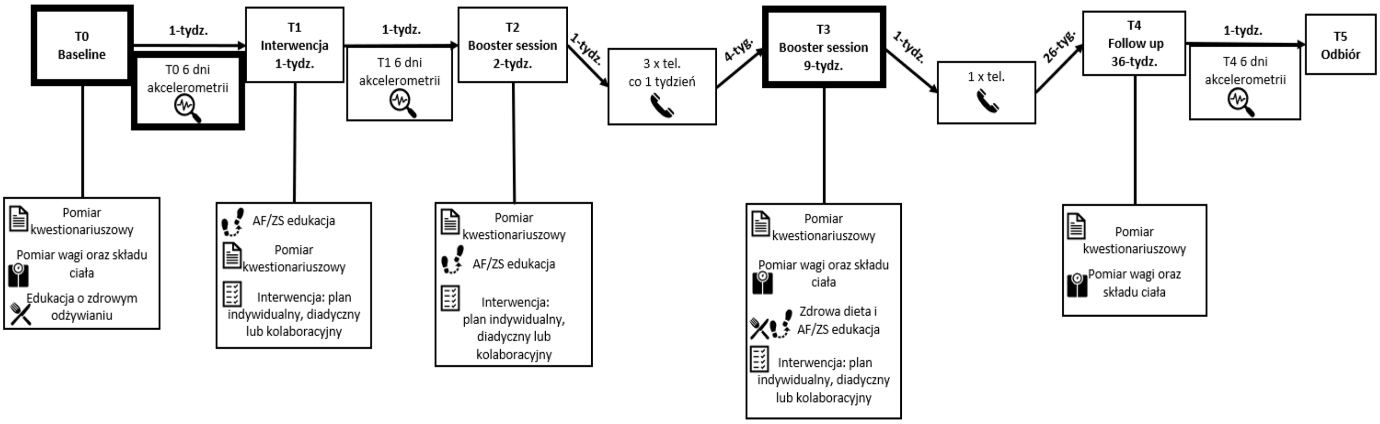
Metoda (Badanie 2)

W Badaniu 2 wykorzystano elementy większego badania zgodne z procedurą badawczą randomizowanego badania z grupą kontrolną, prerejestrowanego w repozytorium

Clinical Trials, nr prerejestracji NCT03011385. Wykorzystane elementy procedury badawczej przedstawia Rycina 3. W Badaniu 2 wykorzystano dane osób docelowych z punktów pomiarowych T0 (pomiar początkowy, przed interwencją dotyczącą planowania) oraz T3 (9 tygodni po pomiarze początkowym).

Rycina 3

Plan Badawczy Badania 2



Nota. T = punkt pomiaru; AF = aktywność fizyczna; ZS = zachowania siedzące. Pogrubione linie oznaczają wykorzystane w Badaniu 2 punkty pomiarowe.

Narzędzia

W Badaniu 2 wykorzystano następujące narzędzia pomiarowe:

Nawyk Aktywności Fizycznej. W pomiarach T0 i T3, w grupie osób docelowych, wykonano pomiar nawyku aktywności fizycznej, który uwzględniał dwie pozycje kwestionariuszowe (Gardner i in., 2012): "Aktywność fizyczna to coś, co robię automatycznie/robię bez zastanowienia", "Aktywność fizyczna to coś, co robię bez konieczności przypominania sobie o tym", odpowiedzi udzielono na skali od 1 = *zdecydowanie nie* do 4 = *zdecydowanie tak.*

Planowanie Indywidualne. W pomiarach T0 i T3, w grupie osób docelowych, wykonano pomiar planowania indywidualnego (Luszczynska i in., 2007), który uwzględniał cztery pozycje kwestionariuszowe: „W ciągu ostatniego tygodnia stworzyłem/am własny plan dotyczące tego: (a) kiedy będę ćwiczyć, (b) gdzie będę ćwiczyć, (c) jakie ćwiczenia będę wykonywać oraz (d) jak często będę ćwiczyć”. Odpowiedzi udzielono na skali od 1 = *zdecydowanie nie* do 4 = *zdecydowanie tak.*

Planowanie Kolaboracyjne. W pomiarach T0 i T3, w grupie osób docelowych, wykonano pomiar planowania kolaboracyjnego (zaadaptowane z Luszczynska i in., 2007), który uwzględniał trzy pozycje kwestionariuszowe: „W ciągu ostatniego tygodnia mój partner i ja stworzyliśmy wspólny plan dotyczący tego: (a) kiedy będziemy razem ćwiczyć, (b) jak często będziemy razem ćwiczyć oraz (c) co/ jakie ćwiczenia będziemy razem wykonywać”. Odpowiedzi udzielono na skali od 1 = *zdecydowanie nie* do 4 = *zdecydowanie tak*.

Kolaboracyjna Kontrola Społeczna. W pomiarze T0 i T3, w grupie osób docelowych, wykonano pomiar kolaboracyjnej kontroli społecznej (Wilson i in., 2010), który uwzględniał dwie pozycje kwestionariuszowe: "Mój partner skłania mnie do nauki nowych umiejętności, które wykorzystuję w sporcie lub w ćwiczeniach" oraz "Mój partner uczestniczył w ćwiczeniach, żebym mógł się do nich przekonać", deklaracje dokonywane były przy użyciu skali od 1 = *nigdy* do 4 = *zawsze*.

Zmienne Kontrolowane. Za pomocą skal samoopisowych weryfikowano płeć, wiek, BMI, edukację, status ekonomiczny, intencję aktywności fizycznej z T0 (Maher i Conroy, 2015) oraz obiektywny pomiar MVPA z pomiaru T0.

Analizy Danych (Badanie 2)

Dane analizowano przy użyciu programu IBM SPSS 26. Braki danych dla zmiennych w modelach głównych zostały uzupełnione za pomocą procedury *full information maximum likelihood.* Użyto liniowych modeli mieszanych do modelowania zmian nawyku aktywności fizycznej, deklarowanego planowania indywidualnego i kolaboracyjnego oraz kolaboracyjnej kontroli społecznej wśród osób docelowych z uwzględnieniem do 9-tygodniowego czasu obserwacji (T0-T3). W celu modelowania efektów Czasu, zmienna czas została zakodowana 0 = 0 tygodni (T0) oraz 9 = 9 tydzień (T3). Modele uwzględniały również analizę efektów interakcji Czasu x Warunku badawczego. Każda z grup eksperymentalnych została zakodowana dychotomicznie, np. 1 = warunek planowania kolaboracyjnego, 0 = pozostałe warunki badawcze, we wszystkich głównych analizach grupa kontrolna stanowiła grupę odniesienia. W celu zbadania stabilności wyników przeprowadzono analizy wrażliwości z uwzględnieniem zmiennych: płeć (1 = mężczyzna, 0 = kobieta), typ związku (1 = romantyczny, 0 = inny) oraz wiek, status ekonomiczny, wykształcenie, intencja aktywności fizycznej z T0 oraz MVPA z T0. Dodatkowo przeprowadzono analizę modeli uwzględniając warunek planowania indywidualnego oraz diadycznego jako grupy referencyjne.

Wyniki (Badanie 2)

Efekty Interwencji Trzech Form Planowania na Nawyk Aktywności fizycznej, Deklarowane Planowanie Indywidualne i Kolaboracyjne oraz Kolaboracyjną Kontrolę Społeczną

Analizy wykazały efekt interakcji Czasu x Warunku badawczego w grupie planowania indywidualnego w porównaniu do grupy kontrolnej (porównaj artykuł nr 2 Kulis, Szczuka, Banik i in., 2022 Tabela 1 i 2). Oznacza to, iż uczestnicy w warunku planowania indywidualnego w T3 uzyskali wzrost o 0,52 punktu na skali nawyku aktywności fizycznej, gdy uczestnicy grupy kontrolnej uzyskali wzrost o 0,20 punktu na skali nawyku.

W porównaniu do grupy kontrolnej wśród osób w grupie planowania diadycznego wystąpiły efekty interakcji Czasu x Warunku badawczego (porównaj artykuł nr 2 Kulis, Szczuka, Banik i in., 2022 Tabela 1 i 2). Uczestnicy planowania diadycznego w T3 uzyskali wzrost o 0,23 punktu na skali deklarowanego planowania kolaboracyjnego, podczas gdy grupa kontrolna uzyskała spadek o 0,14 punktu. Osoby w grupie planowania diadycznego uzyskały również wzrost o 0,30 punktu na skali kolaboracyjnej kontroli społecznej, a grupa kontrolna uzyskała spadek o 0,04 punktu.

Odnosząc się do analiz przeprowadzonych dla uczestników planowania kolaboracyjnego w porównaniu do grupy kontrolnej, uzyskano efekty interakcji Czasu x Warunku badawczego (porównaj artykuł nr 2 Kulis, Szczuka, Banik i in., 2022 Tabela 1 i 2). Uczestnicy planowania kolaboracyjnego w T3 uzyskali wzrost o 0,53 punktu na skali nawyku aktywności fizycznej (podczas gdy grupa kontrolna uzyskała wzrost o 0,20), wzrost o 0,61 punktu na skali deklarowanego planowania indywidualnego (w porównaniu, grupa kontrolna uzyskała wzrost o 0,22), a także wzrost o 0,52 punktu na skali deklarowanego planowania kolaboracyjnego (grupa kontrolna uzyskała spadek o 0,14 punktu) oraz wzrost o 0,32 punktu na skali kolaboracyjnej kontroli społecznej (podczas gdy grupa kontrolna uzyskała spadek o 0,04 punktu).

Wyniki potwierdziły się przy kontroli zmiennych dodatkowych, takich jak wiek, płeć, BMI, edukacja, status ekonomiczny, intencja aktywności fizycznej z T0 oraz MVPA z T0 (porównaj artykuł nr 2 Kulis, Szczuka, Banik i in., 2022).

Dodatkowe analizy: Planowanie Indywidualne oraz Planowanie Diadyczne Jako Grupa Referencyjna

Osoby w warunku kolaboracyjnym deklarowały większy wzrost deklarowanego planowania indywidualnego w porównaniu do osób w warunku indywidualnym, a także większy wzrost planowania kolaboracyjnego w porównaniu do osób w warunku planowania indywidualnego oraz diadycznego (porównaj artykuł nr 2 Kulis, Szczuka, Banik i in., 2022).

Dyskusja Wyników (Badanie 2)

Niniejsze badanie potwierdziło, iż stosowanie różnych form planowania, skutkuje zmianami odmiennych procesów (automatycznych/nawykowych, świadomych procesów samoregulacji, czy też wpływu społecznego), co świadczy o odmiennych mechanizmach trzech rodzajów planowania.

Wśród osób w grupie planowania indywidualnego („Mój plan dla mnie”) odnotowano wzrost nawyku aktywności fizycznej w dziewiątym tygodniu pomiaru. Oznacza to, że najprostsza forma planu pozwala na szybsze wytworzenie się automatyzacji zachowania. Dzieje się tak, gdyż powtórzenie sekwencji interwencji eksperymentalnych (w badaniu własnym 5 razy, tydzień po tygodniu) pozwala na wytworzenie silnego nawyku (Hagger, 2019). Zgodnie z założeniem planowania indywidualnego, potwierdzono również, iż nie uwzględnia ono procesów społecznych.

Wśród osób w grupie planowania diadycznego („Wspólny plan dla mnie”) nastąpił wzrost deklaracji o tworzeniu planów kolaboracyjnych oraz wzrost kolaboracyjnej kontroli społecznej w dziewiątym tygodniu pomiaru. Wyniki potwierdziły, iż planowanie diadyczne uaktywnia procesy wpływu społecznego. Zgodnie z założeniem, przyjęcie roli osoby wspieranej skutkuje zaangażowaniem partnera w proces zmiany, w efekcie wspólnym tworzeniem planów. Planowanie diadyczne powstało w celu zaangażowania partnerów w proces wspierania osoby chorej w zmianie zachowań zdrowotnych (Burkert i in., 2011). Dodatkowo, zaangażowanie partnera w formułowanie planu diadycznego sprawiło, iż plan stał się bardziej obciążający poznawczo i wymagał świadomych procesów samoregulacji, zamiast procesów automatycznych/nawykowych (Hagger, 2019).

W przeciwieństwie do pozostałych grup, planowanie kolaboracyjne („Wspólny plan dla nas”) uaktywniło wszystkie procesy zmiany (procesy automatyczne/nawykowe, świadome procesy samoregulacji i wpływu społecznego) w dziewiątym tygodniu pomiaru. Zgodnie z modelami procesów dualnych zmiana zachowań może być wyjaśniana przeplataniem się procesów automatycznych/nawykowych oraz świadomych procesów regulacyjnych (Hagger i Hamilton, 2020; Strack i Deutsch, 2004). Wyniki badania własnego wskazują, iż w przyszłości powinno się również uwzględnić aktywność procesów społecznych. Planowanie kolaboracyjne jest najbardziej obciążającą formą planowania, w której wymagane jest nie tylko wspólne planowanie, ale również wspólne zaangażowanie w zachowanie. Osiąganie synchronizacji wśród diad romantycznych jest możliwe (Pauly i in., 2020), ale może okazać się wyzwaniem wśród osób będących w innej relacji np. zawodowej czy przyjacielskiej. Przyjęcie najbardziej złożonej formy planowania (tj. planowania kolaboracyjnego) zaangażowało dużą liczbę procesów zmiany, w wyniku czego osiąganie wyznaczonych celów zmiany zachowania okazało się bardziej obciążające i mniej efektywne.

Badanie 3

(por. Kulis i in., rewizje oraz ponowne złożenie do Psychology & Health)

Badanie 3 ma na celu przetestowanie występowania „ubocznych" efektów wywoływanych przez interwencje psychologiczne, które mogą skutkować:

-wzrostem poziomu innych korzystnych dla zdrowia zachowań zdrowotnych (rozumianych jako korzystny efekt uboczny – *spillover effect;* np. skoro ćwiczę regularnie, zmniejszę też ilość wysokokalorycznych przekąsek; Geller i in., 2017),

-redukcją innych korzystnych dla zdrowia zachowań zdrowotnych (czyli efekt kompensacyjny – *compensatory effect*; np. skoro ćwiczę regularnie, to mogę sobie pozwolić na spożywanie większej ilości słodyczy; Geller i in., 2017), lub

-zainicjowaniem zmiany zachowania i związanej z tym zmiany wskaźników zdrowia u osoby bliskiej (tzw. transfer zachowania; *ripple effect*; jeden partner planuje zmianę zachowań, a drugi dzięki tej interwencji również zmienia zachowania/poziom tkanki tłuszczowej; Gorin i in., 2008).

Biorąc pod uwagę wyżej wymienione efekty, zasadna wydaje się ich weryfikacja w kontekście interwencji wykorzystujących różne formy planowania aktywności fizycznej (planu indywidualnego, diadycznego i kolaboracyjnego). Szczególnie ważna jest ocena, czy planowanie zmiany danego zachowania (tj. aktywności fizycznej) może doprowadzić do dodatkowych korzyści wśród obu partnerów diadycznych, np. zmiany procentowego udziału tkanki tłuszczowej lub zmian w odżywianiu, np. redukcji spożywania produktów wysokoenergetycznych, równie ważnego zachowania zdrowotnego u osób mało aktywnych fizycznie (tzw. grupy ryzyka).

Cele (Badanie 3)

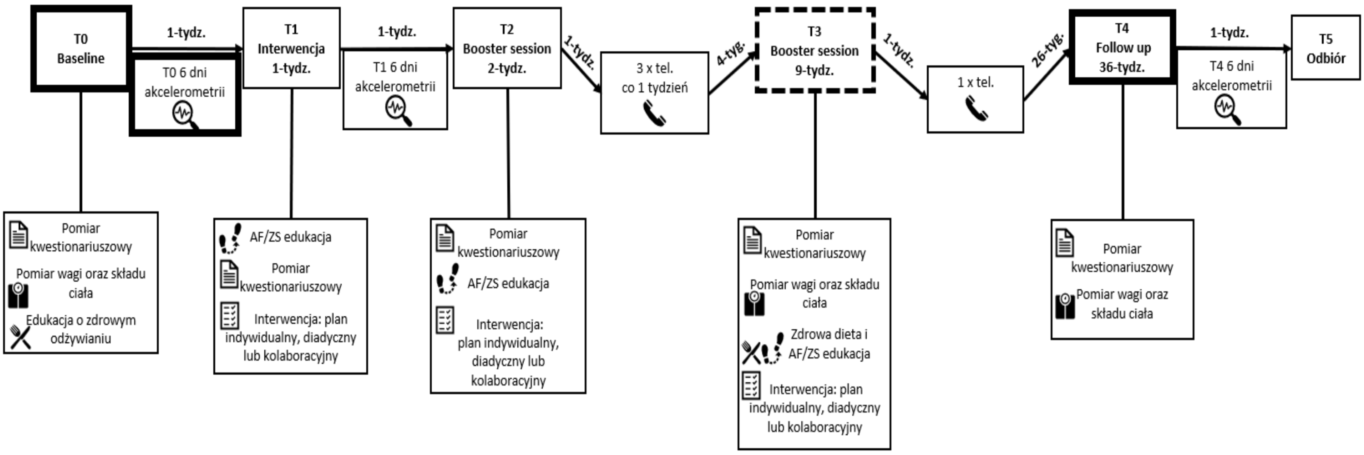
Celem Badania 3 było wyjaśnienie jakie zmiany mogą wystąpić po zastosowaniu interwencji planowania aktywności fizycznej (trzy rodzaje planowania połączone w jeden warunek badawczy) oraz poszczególnych planów aktywności fizycznej (indywidualnych, diadycznych oraz kolaboracyjnych) w takich zmiennych wynikowych jak: procent tkanki tłuszczowej w organizmie, a także spożywanie produktów wysokoenergetycznych. Analizowano zmiany wśród diad, testując czy można uzyskać transfer, czyli zmianę u partnera; kompensację, czyli podejmowanie dodatkowego zachowania niekorzystnego dla zmiany i zdrowia; czy też korzystny efekt uboczny, czyli podejmowanie dodatkowego zachowania korzystnego dla zmiany i zdrowia.

Metoda (Badanie 3)

W Badaniu 3 wykorzystano elementy większego badania zgodne z procedurą badawczą randomizowanego badania z grupą kontrolną, prerejestrowanego w repozytorium Clinical Trials, nr prerejestracji NCT03011385. Wykorzystane elementy procedury badawczej przedstawia Rycina 4. W Badaniu 3 wykorzystano dane osób docelowych oraz partnerów z punktów pomiarowych T0 (pomiar początkowy, przed interwencją dotyczącą planowania), T3 (9 tygodni po pomiarze początkowym, pomiar uznany w modelach jako zmienna kontrolowana) oraz T4 (36 tygodni po pomiarze początkowym, 6 miesięcy od ostatniej interwencji).

Rycina 4

Plan Badawczy Badania 3



Nota. T = punkt pomiaru; AF = aktywność fizyczna; ZS = zachowania siedzące. Pogrubione linie oznaczają wykorzystane w Badaniu 3 punkty pomiarowe; linia przerywana oznacza kontrolowany w modelach pomiar T3.

Narzędzia

W Badaniu 3 wykorzystano następujące narzędzia pomiarowe:

Tkanka Tłuszczowa. W pomiarach T0, T3 oraz T4 wśród osób docelowych oraz partnerów zmierzony został procentowy udział tkanki tłuszczowej za pomocą wagi podłogowej (BF-18 lub BF-530; Beurer, Germany), metodą bioimpedancji (BIA). Analiza składu ciała została wykonana zgodnie ze wskazaniami producenta: badanie wykonywane było na boso i po wcześniejszym zaprogramowaniu wagi (uwzględniając: wzrost, wiek, deklarowany poziom aktywności fizycznej badanego).

Spożywanie Produktów Wysokoenergetycznych. W pomiarach T0, T3 oraz T4 wśród osób docelowych oraz partnerów została zmierzona częstotliwość spożywania oraz rodzaj spożywanych produktów wysokoenergetycznych (Food Frequency Scanner, the National Cancer Institute, 2021). Pomiar obejmował udzielenie odpowiedzi na siedem pozycji kwestionariuszowych, np. „Jak często w ciągu ostatniego miesiąca jadłeś pączki, słodkie bułki, ciasta drożdżowe, francuskie, muffiny? Nie uwzględniaj produktów bez cukru". Badany udzielał odpowiedzi na skali od 0 = *nigdy* do 8 = *2 lub więcej razy dziennie.*

Odpowiedzi zostały przeliczone na wspólną jednostkę czasu (czas na dzień; patrz the National Cancer Institute, 2021). Do obliczeń wykorzystano średnią z udzielonych odpowiedzi.

Zmienne Kontrolowane. Za pomocą skal samoopisowych weryfikowano płeć, wiek, edukację, status ekonomiczny oraz wykorzystano akcelerometryczny pomiar MVPA z pomiaru T0.

Analizy Danych (Badanie 3)

Dane analizowano przy użyciu programu IBM SPSS 27. Braki danych (inne niż procentowy udział tkanki tłuszczowej) zostały uzupełnione za pomocą procedury *full information maximum likelihood*. Użyto liniowych modeli mieszanych do modelowania zmian procentowego udziału tkanki tłuszczowej oraz spożywania wysokoenergetycznych produktów u osób docelowych i partnerów, z uwzględnieniem do 36-tygodnia czasu obserwacji (T0-T4) oraz włączeniem pomiaru T3 jako zmiennej kontrolowanej. W celu modelowania efektów Czasu, zmienna czas została zakodowana 0 = 0 tygodni (T0), 9 = 9 tydzień (T3), 36 = 36 tygodni (T4). Modele uwzględniały analizę efektów interakcji Czasu x Warunku badawczego. W celu weryfikacji skuteczności interwencji planowania wykonano oddzielne analizy: 1) stworzono zmienną „Warunek planowania", który uwzględnił połączenie wszystkich trzech form planowania i został zakodowany dychotomicznie 1 = warunek planowania, 0 = grupa kontrolna, 2) każdą z grup eksperymentalnych analizowano osobno, kodując każdy warunek dychotomicznie np. 1 = warunek planowania kolaboracyjnego, 0 = pozostałe warunki badawcze. We wszystkich głównych analizach grupa kontrolna stanowiła grupę odniesienia. W celu zbadania stabilności wyników przeprowadzono analizy wrażliwości z uwzględnieniem zmiennych: wiek, status ekonomiczny, wykształcenie oraz MVPA z T0, a także płeć (1 = mężczyzna, 0 = kobieta). Dodatkowo przeprowadzono analizy zmiany procentowego udziału tkanki tłuszczowej, w których kontrolowano spożywanie produktów wysokoenergetycznych z pomiarów T0 oraz T3.

Wyniki (Badanie 3)

Efekt Interwencji Planowania na Zmianę Procentowego Udziału Tkanki Tłuszczowej

Analizy przeprowadzone wśród osób docelowych dla warunku planowania (połączonego w jeden warunek badawczy; porównaj artykuł nr 3 Kulis i in., rewizje oraz ponowne złożenie do Psychology & Health Tabela 1 i 2), nie wykazały efektu Czasu oraz efektu interakcji Czasu x Warunku badawczego dla zmiany procentowego udziału tkanki tłuszczowej po 36 tygodniach obserwacji (grupa kontrolna uznana jako referencyjna). Analizy modeli osób docelowych przeprowadzone osobno dla warunku planowania indywidualnego, diadycznego i kolaboracyjnego (porównaj artykuł nr 3 Kulis i in., rewizje oraz ponowne złożenie do Psychology & Health Tabela 1 i 3) również nie wykazały istotnych efektów Czasu i efektów interakcji Czasu x Warunku badawczego dla zmiany procentowego udziału tkanki tłuszczowej po 36 tygodniach obserwacji (grupa kontrolna uznana jako referencyjna). Oznacza to, iż osoby docelowe w połączonym warunku planowania, jak i osoby docelowe w poszczególnych warunkach planowania nie różniły się zmianą procentowego udziału tkanki tłuszczowej w odniesieniu do grupy kontrolnej (patrz Rycina 5).

Analizy przeprowadzone dla partnerów w warunku planowania (połączonego w jeden warunek badawczy; porównaj artykuł nr 3 Kulis i in., rewizje oraz ponowne złożenie do Psychology & Health Tabela 1 i 2), nie wykazały efektu Czasu, ale stwierdzono istotny efekt interakcji Czasu x Warunku badawczego dla zmiany procentowego udziału tkanki tłuszczowej po 36 tygodniach obserwacji (grupa kontrolna uznana jako referencyjna). Analizy modeli obliczonych dla partnerów, przeprowadzone osobno dla warunku planowania indywidualnego, diadycznego i kolaboracyjnego (porównaj artykuł nr 3 Kulis i in., rewizje oraz ponowne złożenie do Psychology & Health Tabela 1 i 3), również nie wykazały istotnego efektu Czasu, ale stwierdzono istotny efekt interakcji Czasu x Planowania diadycznego dla zmiany procentowego udziału tkanki tłuszczowej po 36 tygodniach obserwacji (grupa kontrolna uznana jako referencyjna). Partnerzy w warunku kontrolnym zwiększyli o 0,74% poziom tkanki tłuszczowej, a partnerzy w połączonym warunku planowania zmniejszyli poziom tkanki tłuszczowej o -0,84%, z czego partnerzy warunku planowania diadycznego zmniejszyli poziom tkanki tłuszczowej o -0,85% (patrz Rycina 5).

Podobne efekty Czasu i efekty interakcji Czasu x Warunku wykazały analizy wrażliwości modeli potwierdzając stabilność zmian procentowego udziału tkanki tłuszczowej u osób docelowych i partnerów (porównaj artykuł nr 3 Kulis i in., rewizje oraz ponowne złożenie do Psychology & Health).

Efekt Interwencji Planowania na Zmianę Spożywania Produktów Wysokoenergetycznych

Analizy przeprowadzone wśród osób docelowych oraz partnerów, zarówno w połączonym warunku planowania, jak i warunkach analizowanych osobno, wykazały efekty Czasu (odpowiednio $p < 0{,}001$ oraz $p = 0{,}041$). Zarówno osoby docelowe, jak i partnerzy zredukowali poziom spożywania produktów wysokoenergetycznych o odpowiednio 0,07 i 0,04 punktu (Rycina 5; porównaj również artykuł nr 3 Kulis i in., rewizje oraz ponowne złożenie do Psychology & Health Tabela 1, 2 i 3).

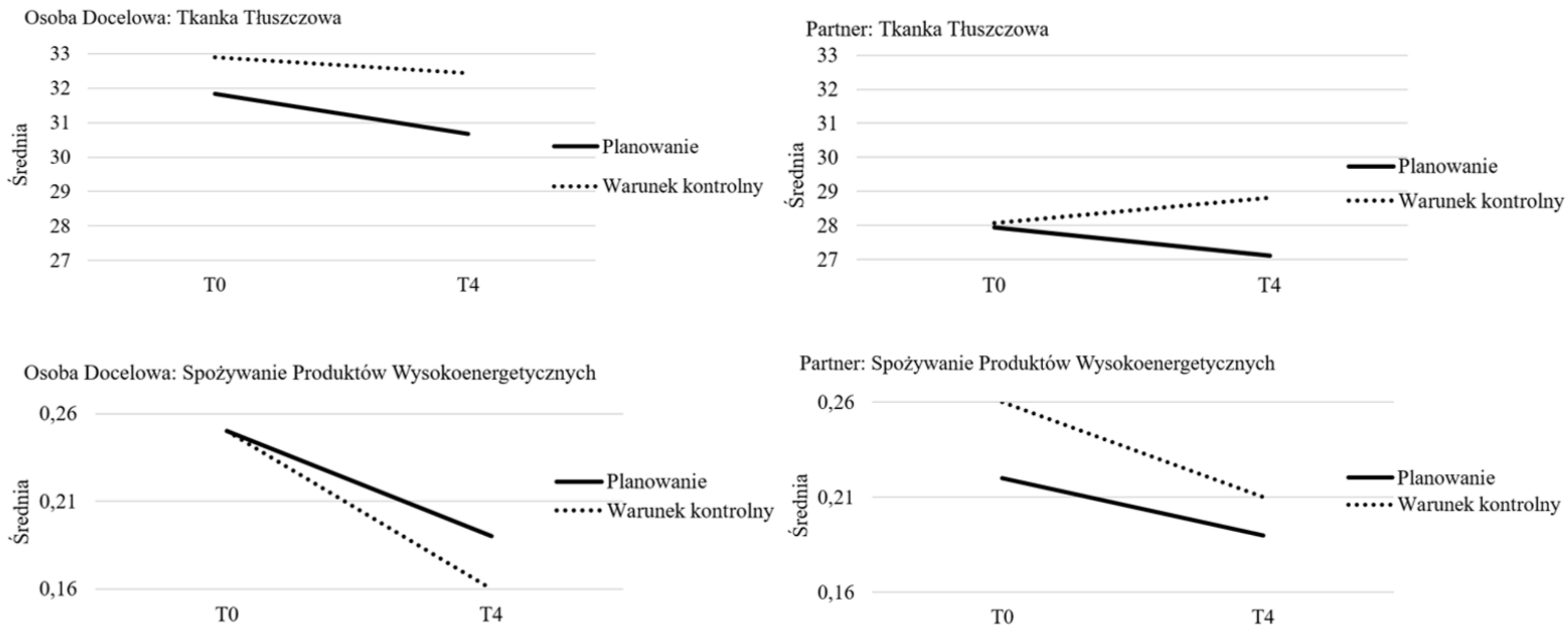
Zarówno u osób docelowych, jak i u partnerów w warunku planowania (połączonego w jeden warunek badawczy; porównaj artykuł nr 3 Kulis i in., rewizje oraz ponowne złożenie do Psychology & Health Tabela 1 i 2) nie wykazano efektu interakcji Czasu x Warunku badawczego dla zmiany spożywania produktów wysokoenergetycznych po 36 tygodniach obserwacji (grupa kontrolna uznana jako referencyjna). Analizy modeli osób docelowych przeprowadzone osobno dla warunku planowania indywidualnego, diadycznego i kolaboracyjnego (porównaj artykuł nr 3 Kulis i in., rewizje oraz ponowne złożenie do Psychology & Health Tabela 1 i 3), wykazały istotny efekt interakcji Czasu x Planowania indywidualnego (*p* = 0,014) dla zmiany w spożywaniu produktów wysokoenergetycznych po 36 tygodniach obserwacji. Osoby docelowe z warunku planowania indywidualnego zredukowały poziom spożywania produktów wysokoenergetycznych o 0,03 punktów skali, podczas gdy osoby docelowe z grupy kontrolnej wykazały większą redukcję spożycia produktów wysokoenergetycznych odpowiednio o 0,09 punków skali (patrz Rycina 5).

Analizy przeprowadzone dla partnerów w połączonym warunku planowania (porównaj artykuł nr 3 Kulis i in., rewizje oraz ponowne złożenie do Psychology & Health Tabela 1 i 2), jaki i weryfikowane osobno dla planowania indywidualnego, diadycznego i kolaboracyjnego (porównaj artykuł nr 3 Kulis i in., rewizje oraz ponowne złożenie do Psychology & Health Tabela 1 i 3), nie wykazały istotnych efektów interakcji Czasu x Warunku dla zmiany w spożywaniu produktów wysokoenergetycznych po 36 tygodniach obserwacji (grupa kontrolna uznana jako referencyjna; patrz Rycina 5).

Podobne efekty Czasu i efekty interakcji Czasu x Warunku wykazały analizy wrażliwości modeli, potwierdzając stabilność zmian spożycia produktów wysokoenergetycznych u osób docelowych i partnerów (porównaj artykuł nr 3 Kulis i in., rewizje oraz ponowne złożenie do Psychology & Health).

Rycina 5

Zmiany Tkanki Tłuszczowej (Górny Panel) i Spożycia Produktów Wysokoenergetycznych (Dolny Panel) u Osób Docelowych i Partnerów w Połączonym Warunku Planowania i Warunku Kontrolnym



Nota. T0 = pomiar początkowy, tydzień przed interwencją eksperymentalną; T4 = 36 tydzień, pomiar follow-up; Planowanie = połączony warunek planowania (połączenie warunku planowania indywidualnego, diadycznego i kolaboracyjnego w jeden warunek pomiarowy). Górny panel: Ryciny prezentują średni poziom procentowej ilości tkanki tłuszczowej u osób docelowych i partnerów. Dolny panel: Ryciny prezentują średni poziom spożycia produktów wysokoenergetycznych przez osoby docelowe i partnerów (zgodnie z the National Cancer Institute, 2021).

Dyskusja Wyników (Badanie 3)

Niniejsze badanie wykazało, iż w porównaniu do grupy kontrolnej, stosowanie planowania aktywności fizycznej nie skutkuje zmianą procentowego udziału tkanki tłuszczowej wśród osób docelowych, natomiast redukcja poziomu tkanki tłuszczowej wystąpiła w grupie partnerów. W odniesieniu do zmian w spożywaniu produktów wysokoenergetycznych, redukcja nastąpiła niezależnie od warunku badawczego. Oznacza to, iż wszystkie osoby badane zredukowały ich spożycie. Jedynie osoby docelowe z warunku planowania indywidualnego wykazały istotnie mniejszą redukcję spożycia produktów wysokoenergetycznych w porównaniu do grupy kontrolnej.

Wyniki potwierdzają występowanie efektu transferu zachowania (*ripple effect*), który dotyczy redukcji tkanki tłuszczowej wśród partnerów diadycznych, w szczególności wśród partnerów z warunku planowania diadycznego. Zgodnie z założeniami planowania diadycznego, partner nie jest głównym odbiorcą interwencji, ale wsparciem dla osoby docelowej w procesie planowania. Wspieranie zmiany skutkuje zmianom zachowań i tym samym zmianom parametrów zdrowotnych wśród partnerów (Berli i in., 2018). Potwierdzają to również założenia diadycznych modeli zmiany zachowań zdrowotnych (Huelsnitz i in., 2022), zgodnie z którymi czynniki związane z relacjami, przekonania i zachowania jednego członka diady wpływają na przekonania i zachowania partnera diadycznego. W efekcie partnerzy również dokonują zmian we własnych zachowaniach zdrowotnych, skutkujących redukcją tkanki tłuszczowej. Zgodnie z wynikami Badania 1, również wśród osób z grupy planowania diadycznego, w tym partnerów, odnotowano największy przyrost MVPA.

Wyniki analiz ukazały brak różnic w redukcji tkanki tłuszczowej wśród osób docelowych we wszystkich grupach planowania oraz mniejszą (niż w grupie kontrolnej) redukcję spożycia produktów wysokoenergetycznych, szczególnie w grupie planowania indywidualnego. Może to świadczyć o uruchomieniu mechanizmu kompensacji po interwencji wywołującej zmianę aktywności fizycznej. Spożywanie produktów wysokoenergetycznych może być silnie nawykowe, co dodatkowo utrudnia proces ich redukcji (Gardner, 2015). Ponadto, przyjęcie roli osoby docelowej, ukierunkowanej na wprowadzenie zmiany poziomu MVPA, czy chorującą przewlekle, powoduje nadmierne obciążenie procesów samoregulacyjnych. Osoby te są skupione na radzeniu sobie z problemami zdrowotnymi i wywołaniu zmian w MVPA i tym samym może mieć u nich miejsce wyczerpanie zasobów samoregulacyjnych potrzebnych do angażowania się w inne zachowanie zdrowotne, jak wprowadzenie zmiany w odżywaniu (Hagger i in., 2010). W efekcie wyczerpania zasobów samoregulacyjnych ograniczona zostaje możliwość zmiany spożywania produktów wysokoenergetycznych. Przeciwnie, przyjęcie roli partnera skutkuje tym, iż efekt kompensacji nie występuje, o czym świadczą zmiany procentowego udziału tkanki tłuszczowej w ich grupie.

Badanie nie wykazało wystąpienia pozytywnego efektu ubocznego (*spillover effect*). Efekt uboczny może się więc ujawniać, gdy badani są zdrowi, zachowania są mniej nawykowe oraz zasoby badanych są mniej obciążone. Możliwe, że spełnienie takich założeń pozwoli na włożenie większego wysiłku w zmianę nowego zachowania.

Podsumowując, wspieranie procesu zmiany sprzyja korzystnej dla zdrowia redukcji tkanki tłuszczowej w grupie partnerów, co wskazuje na obecność efektu transferu (*ripple effect*). Brak zmian u osób docelowych w procentowym udziale tkanki tłuszczowej oraz, w porównaniu do grupy kontrolnej, nieznaczne zmiany w redukcji spożycia produktów wysokoenergetycznych, są raczej przesłanką dla stwierdzenia wystąpienia efektu kompensacji (*compensatory effect*), ale nie dla pojawienia się pozytywnego efektu ubocznego (*spillover effect*).

Konkluzje Ogólne dla Badań 1, 2 i 3

Podsumowując, wyniki badań własnych wskazują na to, iż poszerzenie podejścia do planowania o nowe strategie oddziaływania psychologicznego, takie jak planowanie diadyczne i kolaboracyjne, pozwala na dopasowanie interwencji do kontekstu badań diadycznych i w efekcie do uzyskania zmiany zachowania oraz wskaźników zdrowia, a także na wyjaśnienie mechanizmu działania różnych form planowania. Wszystkie trzy formy planowania skutkują innymi efektami w zakresie zmiany MVPA, angażują odmienne procesy zmiany zachowań zdrowotnych, jak i przyczyniają się do specyficznych zmian zachowań, innych niż te, które są ujęte w procedurze planowana, oraz prowadzą do zmian innych wyznaczników zdrowia.

Przeprowadzone Badanie 1 udzieliło odpowiedzi na pytanie dotyczące tego, który plan aktywności fizycznej działa. Ukazało ono, iż w przeciwieństwie do interwencji planowania indywidualnego i kolaboracyjnego, planowanie diadyczne przyczynia się do wzrostu poziomu MVPA po pół roku od zastosowanego cyklu interwencji. Efekt ten zaistniał zarówno wśród osób docelowych jak i ich partnerów. Dodatkowo, w Badaniu 2 wyjaśniono jak planowanie aktywności fizycznej działa, ukazując, iż poszczególne formy planowania angażują odmienne procesy zmiany. Szczególnie wykazano, że złożoność formy planowania oraz rola partnera w procesie formułowania planów ma znaczenie dla rodzaju oraz ilości zaangażowanych procesów zmiany. Rezultaty badania ukazały, iż planowanie indywidualne aktywizuje procesy automatyczne/nawykowe, planowanie diadyczne aktywizuje świadome procesy samoregulacji oraz procesy wpływu społecznego, a planowanie kolaboracyjne, jako najbardziej wymagająca forma planowania zmiany, aktywizuje wszystkie procesy zmiany (automatyczne/nawykowe, świadome dot. samoregulacji oraz społeczne).

Biorąc pod uwagę wyniki Badania 1 oraz Badania 2, jeżeli planowanie nie uwzględnia obecności procesów społecznych lub jest zbyt złożone, nie będzie przyczyniało się do zmian

MVPA. Planowanie diadyczne, jako jedyne uwzględnia odmienne role każdej osoby w diadzie, dlatego osoby z deficytami aktywności fizycznej lub chorujący przewlekle (osoby docelowe) mogą w znaczącym stopniu skorzystać z zaangażowania bliskiej osoby (partnera) w pomoc w zmianie zachowania, która skutkuje u nich wzrostem MVPA. Partnerzy również korzystają z udzielanej pomocy zwiększając własny poziom MVPA.

Badanie 3 udzieliło odpowiedzi na pytanie czy planowanie aktywności fizycznej może wywołać zmiany w innych zachowaniach zdrowotnych niż zakłada dana procedura planowania oraz/lub doprowadzić do zmiany we wskaźnikach zdrowia, takich jak zmiana procentowego udziału tkanki tłuszczowej. Analizy wykazały, iż planowanie aktywności fizycznej, szczególnie planowanie diadyczne, może skutkować redukcją tkanki tłuszczowej w grupie partnerów, co stanowi przesłankę dla wystąpienia efektu transferu (*ripple effect*). Osoby uczestniczące w planowaniu diadycznym to również grupa badawcza, która w największym stopniu zwiększyła swój poziom MVPA (zgodnie z Badaniem 1), a także zaangażowała społeczne i świadome samoregulacyjne mechanizmy pośredniczące (zgodnie z Badaniem 2). Brak zmian tkanki tłuszczowej wśród osób docelowych, połączony z nieznaczną redukcją spożywania produktów wysokoenergetycznych, jest przesłanką dla zaistnienia efektu kompensacji (*compensatory effect*), zamiast pozytywnego efektu ubocznego (*spillover effect*).

Poszukiwanie nowych oddziaływań psychologicznych w celu zmiany zachowań zdrowotnych oraz wzmocnienia siły strategii samoregulacyjnych jest ważnym aspektem dla zwiększenia poziomu aktywności fizycznej przez społeczeństwo, które zmaga się z konsekwencjami niedoboru aktywności fizycznej (WHO, 2022a) oraz dla lepszego rozumienia, jak dopasować interwencję uwzględniającą planowanie (Hagger i Luszczynska, 2014). Przeprowadzone badania podkreślają rolę interwencji planowania zastosowaną wśród diad oraz rolę kontekstu społecznego dla zmiany zachowań zdrowotnych. Badania prowadzone w obszarze planowania aktywności fizycznej, szczególnie planowania diadycznego, biorą pod uwagę odmienne role badanych, co pełni kluczowe znaczenie w samym procesie zmiany, jak i w wyjaśnianiu jego mechanizmu.

Przeprowadzony cykl badań niesie za sobą implikacje praktyczne: interwencje zmiany zachowań zdrowotnych w przyszłości powinny uwzględniać planowanie diadyczne w celu zwiększenia aktywności fizycznej wśród osób docelowych, jak i ich partnerów, gdyż angażuje ono pośredniczące mechanizmy społeczne oraz świadome procesy regulacji zachowania, które wspierają proces zmiany. Dodatkowo, pełnienie przez partnerów roli pomocowej, szczególnie w kontekście planowania diadycznego, może skutkować redukcją tkanki tłuszczowej w ich grupie. Wśród osób docelowych, czyli niespełniających rekomendacji dla aktywności fizycznej i/lub chorujących przewlekle, zastosowanie interwencji planowania diadycznego przede wszystkim może skutkować zmianą zachowania, które interwencja ma wywołać. Można się również spodziewać, iż zastosowanie jakiejkolwiek formy planowania w grupie osób docelowych przyczyni się do obciążenia ich zasobów samoregulacyjnych i w rezultacie skutkuje problemami w zmianie innych zachowań zdrowotnych. Powstałe problemy mogą przejawiać się stosowaniem zachowań kompensacyjnych, których efektem będzie większa trudność w redukcji tkanki tłuszczowej (zjawisko uznane jako efekt kompensacji; *compensatory effect*).

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Spis Publikacji Naukowych

Spis Publikacji Naukowych Stanowiących Spójny Tematycznie Zbiór Artykułów

1. Kulis, E., Szczuka, Z., Keller, J., Banik, A., Boberska, M., Kruk, M., Knoll, N., Radtke, T., Scholz, U., Rhodes, R. E., & Luszczynska, A. (2022). Collaborative, dyadic, and individual planning and physical activity: A dyadic randomized controlled trial. *Health Psychology*, *41*(2), 134–144. https://doi.org/10.1037/hea0001124

2. Kulis, E., Szczuka, Z., Banik, A., Siwa, M., Boberska, M., Knoll, N., Radtke, T., Scholz, U., Rhodes, R. E., & Luszczynska, A. (2022). Insights into effects of individual, dyadic, and collaborative planning interventions on automatic, conscious, and social process variables. *Social Science & Medicine*, *314*, 115477. https://doi.org/10.1016/j.socscimed.2022.115477

3. Kulis, E., Szczuka, Z., Banik, A., Siwa, M., Boberska, M., Zarychta, K., Zaleśkiewicz, H., Knoll, N., Radtke, T., Scholz, U., Schenkel, K., & Luszczynska, A. (revise and resubmit). Physical activity planning interventions, body fat and energy-dense food intake in dyads: Ripple, spillover, or compensatory effects? (revise and resubmit to the *Psychology & Health*)

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We, the undersigned, co-authors of the above publication, confirm that the above publication has not been submitted as evidence for which a degree or other qualification has already been awarded.

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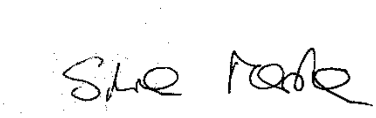

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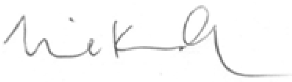

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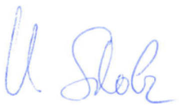

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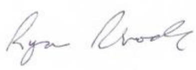

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Artykuł 1: Collaborative, Dyadic, and Individual Planning Intervention and Physical Activity: A Dyadic Randomized Controlled Trial

Kulis, E., Szczuka, Z., Keller, J., Banik, A., Boberska, M., Kruk, M., Knoll, N., Radtke, T., Scholz, U., Rhodes, R. E., & Luszczynska, A. (2022). Collaborative, dyadic, and individual planning and physical activity: A dyadic randomized controlled trial. *Health Psychology*, *41*(2), 134–144. https://doi.org/10.1037/hea0001124

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Collaborative, Dyadic, and Individual Planning and Physical Activity: A Dyadic Randomized Controlled Trial

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Objective: This study was designed to investigate the effects of collaborative, dyadic, and individual planning on moderate-to-vigorous physical activity (MVPA) in target person–partner dyads. Individual planning reflects an "I-for-me" planning of one person's behavior. Collaborative planning refers to joint planning of both dyad members' behavior ("We-for-us" planning), and dyadic planning refers to joint planning of only the target person's behavior ("We-for-me" planning). ***Method:*** $N = 320$ dyads of target persons (M age: 43.86 years old) and partners (M age: 42.32 years old) participated in a randomized controlled trial (ClinicalTrials.gov registration no. NCT03011385) with three experimental planning conditions (collaborative, dyadic, or individual planning) and an active control condition (physical activity, sedentary behavior, and nutrition education). Target persons did not meet international MVPA guidelines or were recommended to increase their MVPA due to cardiovascular disease or type II diabetes. MVPA was measured with ActiGraph wGT3X-BT accelerometers at baseline, 1-week follow-up, and 36-week follow-up (6 months after the final intervention session; the primary endpoint). Linear mixed models were fit for target persons and partners separately. ***Results:*** At 1-week follow-up, there were no significant Time × Condition interaction effects among target persons and partners. At 36-week follow-up, target persons and partners in the dyadic planning conditions increased their MVPA, compared to the control condition. ***Conclusions:*** Individuals with insufficient physical activity or with a cardiovascular disease/type II diabetes and their partners may benefit from dyadic planning, which is a promising strategy to achieve physical activity increases.

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Higher levels of physical activity (PA) are associated with lower morbidity (e.g., due to cardiovascular diseases and type II diabetes), lower depression and anxiety symptoms, better sleep, and better cognitive health (World Health Organization [WHO], 2020b). The WHO (2020b) recommends that adults should perform at least 150–300 minutes per week of moderate-intensity physical activity (MPA) or at least 75–150 minutes per week of vigorous intensity physical activity (VPA), or an equivalent combination of both. Globally, at least 28% of adults do not meet the WHO (2010) recommendations (Guthold et al., 2018). Identifying effective means to improve PA remains one of the key tasks of health psychology.

Health behavior change frameworks such as implementation intentions (L. Keller et al., 2020) or the health action process approach (Schwarzer & Luszczynska, 2015) suggest that health behavior is determined by intention formation, followed by individual planning ("I-for-me" planning). Individual action plans include links between characteristics of future situations and desired behaviors ("when," "where," and "how" behaviors will be enacted), whereas individual coping planning refers to identifying potential barriers and planning how to overcome them (Hagger & Luszczynska, 2014; Hagger et al., 2016). Action and coping planning are listed by Michie et al. (2013) in their taxonomy of techniques that have a potential to prompt behavior change. Reviews showed small-to-medium or medium effects of individual planning, usually observed after follow-ups < 3 months and in studies using self-reported PA (Bélanger-Gravel et al., 2013; Carraro & Gaudreau, 2014).

The individual approach to planning disregards the fact that self-regulatory and behavioral processes may occur in social contexts (Hagger et al., 2016; Rhodes et al., 2020; Rothman et al., 2020). In contrast, approaches accounting for cognitions and behaviors of partners, family members, or friends of individuals who intend to change their behavior may help to better understand behavior change processes occurring in complex social contexts (Rhodes et al., 2020). A dyad including two people in a close relationship can be considered to form one regulatory system, collaborating in processes of goal setting and goal pursuit (Berli et al., 2018). Merely observing and/or supporting the process of behavior change of the other person in the dyad may influence one's own behavior (Berli et al., 2018).

Previous research developed two approaches to extend individual planning to the dyadic level: these are dyadic planning (Burkert et al., 2011, 2012) and collaborative planning (Prestwich et al., 2012). In the dyadic ("We-for-me") planning, a target person plans their own future behavior, whereas the main role of the partner is to assist in plan formation (Burkert et al., 2011; J. Keller et al., 2020; Knoll et al., 2017). Collaborative ("We-for-us") planning occurs when a target person and their partner jointly form plans together, and the plans refer to joint PA behavior enactment (Prestwich et al., 2012).

Despite the logical basis for collaborative and dyadic planning, existing evidence has provided mixed conclusions regarding its efficacy in PA change. For example, compared to individual planning and a control condition, collaborative planning predicted more PA bouts among target persons, measured with self-reports at 6-month follow-up (Prestwich et al., 2012). The influence of planning on partners' PA was not assessed (Prestwich et al., 2012). A study comparing effects of collaborative and individual planning among people with type II diabetes indicated that neither type of planning influenced accelerometer-measured moderate-to-vigorous physical activity (MVPA) at 6-week follow-up, however, there was an increase of self-reported PA among patients who formed collaborative plans (Wooldridge et al., 2019). Again, the intervention's effects on partners' PA were not assessed (Wooldridge et al., 2019). Using accelerometer-based data, Knoll et al. (2017) found no differences between dyadic planning, individual planning, and the control condition in target persons' MPA and VPA at 6-week follow-up, whereas initially significant effects of dyadic planning on partners' VPA were not sustained over time. Furthermore, a limited number of research used longer follow-ups to assess the effects of planning interventions. According to the transtheoretical model of behavior change (Prochaska & DiClemente, 1983), effects of an intervention should be observed for at least 6 months to establish if an uptake of a healthy behavior is maintained.

In sum, the evidence for long-term (i.e., 6-month) effects of collaborative or dyadic planning on objectively assessed PA is inconclusive. There is no sufficient empirical background for a formulation of specific hypotheses, proposing a superiority of one type of planning over another or for hypothesizing that compared to partners, target persons may benefit more from dyadic or collaborative planning. Additionally, the theoretical advancements in dyadic and collaborative planning were developed independently (Burkert et al., 2011; Prestwich et al., 2012). The existing theoretical models of planning do not provide suggestions on which type of planning may be superior in a specific context, or whether the effects may be observed in both dyadic partners.

The purpose of this randomized controlled trial was to investigate the effects of three types of planning on MVPA among target persons and partners who formed a dyad of individuals in romantic relationship (either married or cohabiting), close friends, coworkers, or family members. In particular, we investigated if target persons and/or partners assigned to collaborative, dyadic, and individual planning condition would increase their MVPA minutes, compared to an active control (education) condition. Effects of three types of planning on the primary outcome (accelerometer-measured MVPA) were evaluated at 1-week follow-up (i.e., directly after delivering the first planning/education session) and at the primary endpoint, 36-week follow-up (6 months after delivering the last planning vs control sessions).

Method

Participants

The target sample included adults from general population who: (a) did not meet the WHO (2010) MVPA recommendations valid for the time of data collection, and/or were recommended to increase their MVPA levels due to cardiovascular diseases/type II diabetes; and (b) had an adult partner willing to participate with them in this study. The study inclusion criteria were: (a) based on self-reported information obtained during the recruitment, a dyad was included if the target person was performing $<$ 150 MVPA minutes per week, as suggested in the WHO (2010) recommendations (valid for the date when data collection was initiated) and/or had a cardiovascular disease and/or type II diabetes (and received recommendations from a physician or rehabilitation specialist to increase their PA levels); (b) target persons reported at least a moderate intention to perform regular PA; and (c) a target person and their dyadic partner were in a romantic, familial, amicable, and/or working relationship for at least 1 year and meeting regularly (at least several times a week). Participants were recruited with strategies such as advertisements in newspapers or social media, in-person recruitment at public events, in health care organizations, senior clubs, and nongovernmental organizations. In case both dyad members did not meet PA guidelines and none had a cardiovascular disease or type II diabetes, the roles of the target person and partner were self-assigned by the dyad. Otherwise, the study staff proposed the role of the target person to the individual who did not meet PA guidelines and/or were recommended by a physician to increase their PA.

At baseline (Time 0 [T0]), N = 320 adult dyads were enrolled (see Figure 1 for participant flow). Target persons' (64.4% women) mean age was 43.86 years (SD = 17.02; range: 18–90); their average body mass index (BMI) was 28.03 (SD = 6.42; 61.8% overweight or obese). Partners' (64.1% women) mean age was 42.32 years (SD = 16.55; range: 18–84) and their average BMI was 25.69 (SD = 4.60, 51.6% overweight or obese). Most target persons (57.5%) and partners (56.8%) reported a university degree; 40.3% of target persons and 41.9% of partners reported a high school degree or a vocational education; 2.2% of target persons, 1.3% of partners had primary education. Half of the target persons (52.2%) and partners (49.4%) reported an average economic status; 42.2% of target persons (43.7% of partners) indicated their economic status to be above average; 5.6% of target persons (6.9% of partners) indicated that it was worse compared to the average family in Poland. All participants were White, as is 99% of the population of Poland. Overall, 39.4% of target persons and 16.7% of partners reported a cardiovascular disease and/or type II diabetes; other illnesses (e.g., musculoskeletal) were reported by 27.2% of target persons and by 24.5% of partners. In most dyads, target persons and partners were in a romantic relationship (married or cohabiting; 61.6%); 38.4% of dyads were in other relationships. Participants' characteristics across the four study groups are provided in the online supplemental materials (Table S1).

Based on self-reports obtained prior to randomization/T0 measurement, 87.8% of target persons did not meet PA recommendations (WHO, 2010), remaining 12.12% reported that they received the recommendation to increase PA due to cardiovascular diseases/type II diabetes. Among partners, 77.5% did not meet PA recommendations (WHO, 2010).

Design and Procedure

This study reports primary findings of a randomized controlled study, registered at ClinicalTrials.gov (# NCT03011385), with measurement points spanning 36 weeks (see Figure 2). Time 0 (T0, baseline), Time 1 (T1), and Time 2 (T2) took place 1 week apart, respectively; Time 3 (T3) took place at 9 weeks after T0, followed by Time 4 (T4) at 36 weeks after T0. The primary outcome (accelerometer-based MVPA minutes) was assessed at T0, T1, and T4. Figure 2 presents the study timeline, intervention modality, dose, the order of experimental procedures, and measurement for each session/measurement point. For detailed description see the online supplemental materials and the preregistration (ClinicalTrials.gov, NCT03011385).

Data were collected at 31 locations (24 urban, 7 rural) in South West Poland, between February 2016 and February 2020 (until reaching the targeted sample size). To collect data and deliver experimental procedures, a total of 38 persons (psychologists, psychology master students, nurses, teachers) were trained, with at least two training sessions prior to the study (plus regular supervision across the study period). Data collection and experimental/control group procedures were conducted at locations agreed upon with the dyads (e.g., the university, school nurse offices, or participants' homes).

The study was approved by Ethics Committee at SWPS University, Wroclaw, Poland. Both members of the dyads provided informed consents. All procedures were conducted in accordance with 1964 Helsinki declaration and its later amendments. Personal codes were used to secure anonymity. Participants received small gifts (the average value of up to 10 €) after each face-to-face session. There was no further reimbursement.

Randomization and Blinding

After assessment of inclusion criteria but prior to T0 measurement, dyads were randomized to one of four conditions: collaborative planning (n = 79), dyadic planning (n = 83), individual planning (n = 82), and the control condition (n = 76). The randomization was conducted using a random digit generator and not stratified. The researcher conducting randomization was blinded to the participant enrollment and the intervention assignment.

Intervention and Control Group Procedures

The following behavior change techniques (BCTs; Michie et al., 2013) were used in the three planning conditions: action planning, barrier identification, prompting self-talk, social support, relapse prevention/coping planning. Applications of all BCTs included references to collaborative, dyadic, or individual planning, respectively.

Face-to-face format was chosen based on previous research on planning interventions among involving people with type II diabetes (Knäuper et al., 2018) or overweight/obesity (Luszczynska et al., 2007). Weekly contact schedule for planning interventions was based on previous research, using weekly planning sheets in the interventions (Knäuper et al., 2018; Luszczynska et al., 2007). Inclusion of at least two planning sessions was based on previous research testing booster planning sessions (Chapman & Armitage, 2010; Scholz et al., 2013).

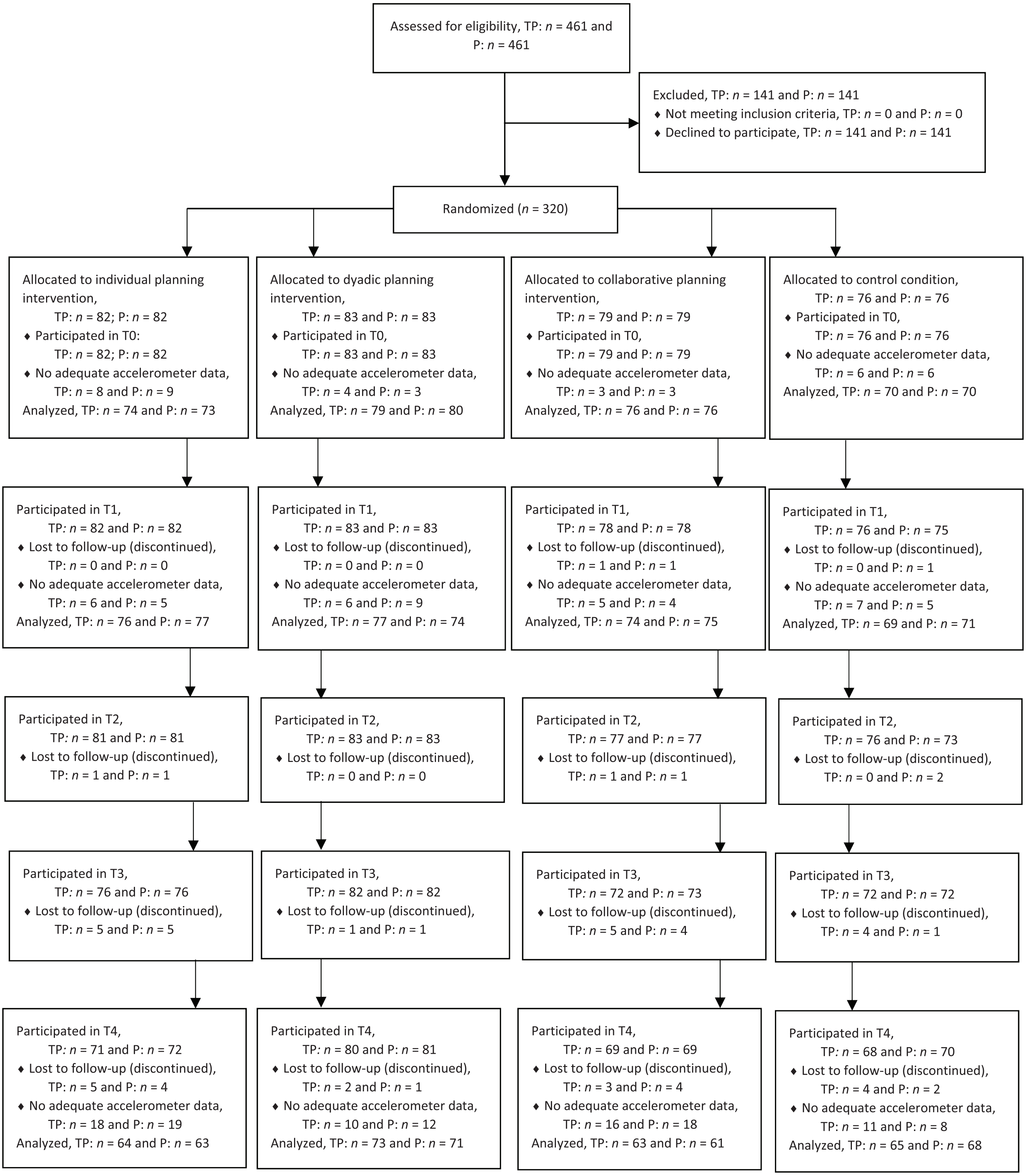
Education procedures (included in the active control and planning groups) comprised physical activity, sedentary behavior, and nutrition education (WHO, 2020a, 2020b), added to address the needs of participants with cardiovascular diseases, type II diabetes, or overweight (see Knäuper et al., 2018; Luszczynska et al., 2007; for further detail see the online supplemental materials).

Control Condition

Target persons and their partners participated in education procedures, including four face-to-face individual sessions and four

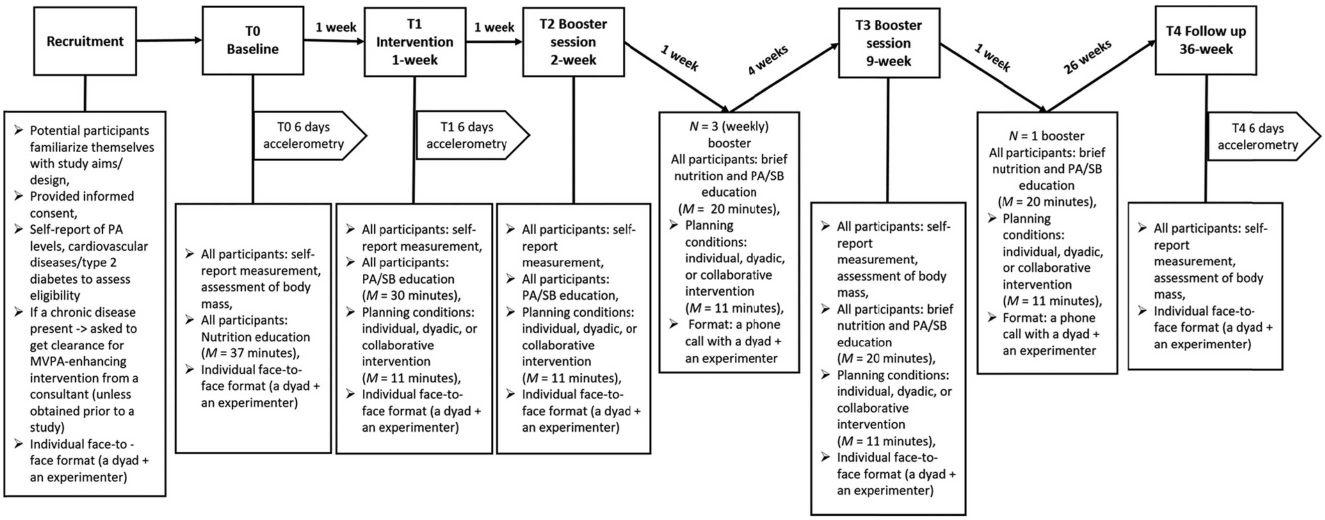
Figure 1

The Participant Flow Diagram



Note. TP = target persons; P = partners.

Figure 2
The Measurement and Intervention Points Over Time



Note. The figure presents the study procedures conducted in target person–partner dyads (N = 320). T = Time; PA = physical activity; SB = sedentary behaviors.

booster phone calls (for order of education components and delivery details see Figure 2 and online supplemental materials).

Collaborative Planning Condition

The collaborative "We-for-us" planning face-to-face intervention sessions included the following steps: (a) an instruction about the aims of action planning, the content of plans ("when, where, and how you will perform physical activity together"); (b) presenting dyads with planning sheets; (c) asking the target person and partner to think about MVPA that they find enjoyable and feasible for both of them; inviting them to write up a joint plan on "when," "where," and "how" they could do these activities in the following week. Participants were asked to form at least one complex collaborative action plan for the following week (7 days); (d) reflecting on whether the plans fit the schedule and the needs of participants; (e) an instruction about the aims of coping planning and how to make a coping plan; (f) a discussion between the partners and writing up to three potential barriers and respective coping responses in the "if . . . then . . ." format using a coping planning sheet. Participants were asked to form at least one complex collaborative coping plan for the following week; (g) reflecting on whether the coping plans fit the schedule and needs of participants; (h) participants took the filled in planning sheets to their home and were provided with spare copies of planning sheets (to be used during the booster phone calls).

During the booster phone calls an experimenter asked dyads about the implementation of their collaborative plans in the previous week. Next, participants were encouraged to form specific collaborative action and coping plans for the following week, using the spare copies of the planning sheets. The planning procedure was based on Prestwich et al. (2012), Knäuper et al. (2018), and Luszczynska et al. (2007). For details see the online supplemental materials.

Dyadic Planning Condition

The dyadic planning intervention used similar procedures to those applied in the collaborative planning condition. However, during the dyadic "We-for-me" planning session the target persons formed their own plans whereas partners were instructed to assist the formation of the plans (see online supplemental materials).

Individual Planning Condition

The individual "I-for-me" planning intervention included procedures parallel to those applied in the collaborative and dyadic planning. The target persons and partners were asked to form plans individually, independently of each other, addressing their own PA (see online supplemental materials).

Measures

Moderate-to-Vigorous Physical Activity: Primary Outcome (T0, T1, T4)

MVPA minutes per day were assessed using accelerometers ActiGraph wGT3X-BT. At T0, T1, and T4, participants were instructed to wear the accelerometer on their right hip during waking hours (at least 14 hr) for 6 consecutive days. Valid wear times were assessment periods in which the accelerometer was worn for $>$ 3 days and for $>$ 8 hr per day (i.e., valid wear day; e.g., Prescott et al., 2020). Sasaki et al.'s (2011) algorithm was used to count MVPA category in minutes per day. Daily minutes of MVPA for each valid wear day were summed up and divided by the number of valid wear days. Univariate outliers ($z > |3.29|$) were winsorized to one unit lower/higher than the next highest or lowest value in the distribution, respectively. Data obtained during the first valid wear day at T0 were excluded. Additionally, separate indices of MPA and VPA minutes per day were calculated and analyzed. Finally, self-reported MVPA assessment was used to determine if participants met inclusion criteria related to insufficient MVPA (see online supplemental materials).

Physical Activity Intention (T0)

At T0, PA intention was measured in target persons and partners with two items (Maher & Conroy, 2015); for example, "I intend to engage in several 30-minute sessions of moderate physical activity in the next week." The responses ranged from 1 = *definitely not* to 4 = *definitely yes*. Two items were moderately correlated (target persons: $r = .57$, $p < .001$, $M = 2.55$, $SD = .86$, partners: $r = .50$, $p < .001$, $M = 2.66$, $SD = .89$).

Self-Reported Own Plans and Collaborative Plans (T2)

To conduct the manipulation check, self-reported own and collaborative planning was assessed with three items each (Schwarzer et al., 2008); for example, "During the last week I have formed my own plans regarding when to exercise," "During the last week, I and my partner have formed joint plans regarding where to exercise together." Response scales, descriptive statistics, and reliability coefficients are reported in the online supplemental materials.

Control Variables (T0)

Body weight and height were assessed with a medically approved telescopic height measuring rods and floor scales (BF-18 or BF-530; Beurer, Germany, measurement error < 5%). Participants' gender, age, education, perceived economic status ("Compared with the average economic status of families in the country, how would you rate the economic status of your family?"; the responses ranging from 1 = *much below the average* to 5 = *much above the average*), and the type of relationship (1 = romantic; 0 = other) were assessed at T0.

Data Analysis

Data of target persons and partners were analyzed separately using IBM SPSS 26. Linear mixed models were used to model MVPA as the continuous outcome up to 1-week follow-up and 36-week follow-up. For conducting descriptive and attrition analyses and randomization checks missing data (other than accelerometer-based) were accounted for using the full information maximum likelihood method. Assuming medium effects (Bélanger-Gravel et al., 2013) of $\varsigma^2 = 25$, power of .80, $p = .05$, and four experimental conditions, the sample should include 279 dyads (obtained with a G*Power calculator).

To examine between-condition differences of target persons' and partners' MVPA, we modeled three dummy-coded planning conditions as predictors, with the control condition as the reference group. To model effects over time, a time variable was included as a predictor, with the following coding: "0" for baseline (T0), "1" for 1-week follow-up, and "36" for 36-week follow-up. Interactions between time and the three planning conditions were added as predictors. All analyses were controlled for gender ("1" = male, "0" = female) and grand-mean centered age and BMI. Random effects of time and intercepts were tested. In case of analyses conducted for 1-week follow-ups the models with random time effects did not converge, therefore random time effects were excluded from respective equations. To test for the robustness of findings, sensitivity analyses were conducted, controlling for additional covariates such as economic status, education, PA intention, and the type of relationship. Additionally, a moderation analysis was conducted to test the Time × Condition × Type of Relationship interaction, followed by an investigation of the effects of the planning interventions on MPA and VPA analyzed separately. The true R^2 (the squared correlation between the actual outcome and the outcome predicted by fixed effects; Hoffman, 2015) was computed to estimate the size of total effects. Within-group Cohen's *d*s were computed. Within-group values of > 0.50 of standard deviation for change were calculated as representing minimally clinically important differences (MCID; Norman et al., 2003).

Results

Preliminary Analysis: Attrition, Randomization, and Manipulation Checks

Attrition analyses indicated that target persons and partners who dropped out after T0 did not differ from completers in terms of baseline assessments of age, gender, economic status, education, BMI, the type of relationship, PA intention, or MVPA (all *F*s < 3.31, all *p*s > .070 and all χ^2s < 1.07, all *p*s > .301; see online supplemental materials). Comparisons of participants who completed accelerometer-based assessments versus those who did not complete respective assessments indicated differences in age of target persons and partners, and differences in target persons' BMI (see online supplemental materials). The associations between being diagnosed with cardiovascular disease/type II diabetes and MVPA at T4 were not significant among target persons ($p = .094$) and partners ($p = .421$).

Missing data for age, gender, BMI, education, economic status, PA intention, the type of relationship, MVPA, was missing completely at random for target persons, Little's MCAR $\chi^2(95) = 107.07$, $p = .187$, and partners, Little's MCAR $\chi^2(84) = 71.32$, $p = .836$.

Randomization checks indicated no between-condition differences at T0 for gender, economic status, education, the type of relationship, PA intention, BMI, MVPA (all *F*s < 2.45, all *p*s > .064 and all χ^2s < 5.83, all *p*s > .120; see online supplemental materials). There were no between-condition differences in target persons' age, but there was a difference regarding partners' age, $F(3, 317) = 2.92$, $p = .034$ (see online supplemental materials).

Results of the manipulation check are reported in detail in the online supplemental materials. Partners assigned to individual or collaborative conditions (i.e., forming the plans for their own PA) reported forming their own PA plans more often ($p = .017$) than partners assigned to the control or dyadic conditions (i.e., partners who did not plan their own PA). Target persons and partners assigned to the collaborative condition reported forming collaborative PA plans more often at T2 (all *p*s < .001), compared to participants in other conditions. Concluding, the observed differences were in line with patterns that may be expected across the study groups.

No unintended effects or harms due to study participation were observed.

Effects of Collaborative, Dyadic, and Individual Planning on MVPA

Descriptive statistics for MVPA (average minutes/day) of target persons and partners are displayed in Table 1. Table 1 also reports changes in MVPA minutes across the study groups, indicating the

Table 1

Moderate-to-Vigorous Physical Activity (Minutes per Day): Descriptive Statistics, Within-Group Differences, Effects Sizes, Internal Consistency Coefficients

Measurement points	Collaborative planning condition (n = 79)		Dyadic planning condition (n = 83)		Individual planning condition (n = 82)		Control condition (n = 76)	
	Target person *M* (*SD*)	Partner *M* (*SD*)	Target person *M* (*SD*)	Partner *M* (*SD*)	Target person *M* (*SD*)	Partner *M* (*SD*)	Target person *M* (*SD*)	Partner *M* (*SD*)
T0 mean	74.63 (33.20)	76.89 (32.56)	69.45 (31.36)	83.25 (31.09)	71.94 (30.07)	82.83 (30.04)	78.25 (30.66)	83.91 (34.26)
T1 mean	77.42 (35.60)	78.47 (32.05)	72.34 (29.48)	84.05 (29.41)	74.76 (31.51)	87.23 (35.00)	74.96 (29.26)	84.43 (34.38)
T4 mean	78.37 (37.68)	72.49 (31.52)	74.52 (30.86)	84.54 (30.60)	69.54 (30.70)	81.01 (34.33)	73.18 (25.85)	79.81 (33.16)
T0–T1 $mean_{diff}$	**2.79**	**1.58**	**2.89**	0.80	**2.82**	**4.40**	**−3.29**	0.52
T0–T1 Cohen's d	−0.08	−0.05	−0.10	−0.03	−0.09	−0.16	0.11	−0.02
T0–T4 $mean_{diff}$	**3.74**	**−4.40**	**5.07**	**1.29**	**−2.40**	−1.82	**−5.07**	**−4.10**
T0–T4 Cohen's d	−0.11	0.14	−0.16	−0.04	0.08	0.03	0.18	0.12
ICC	.76	.59	.70	.66	.51	.70	.59	.76

Note. T0 = baseline accelerometry; T1 = the follow-up accelerometry, the week directly after T0; T4 = the follow-up accelerometry, 36 weeks after T0; ICC = Intraclass correlation coefficient. For sample sizes at each measurement point see Figure 1. Values marked in bold represent changes (increases and decreases) in moderate-to-vigorous physical activity (MVPA) minutes per day, which may be interpreted as above the threshold for the minimally clinically important difference (values of change in MVPA minutes per day above 0.50 of the value of standard deviation for change); $mean_{diff}$. = mean difference values.

values above MCDI threshold (i.e., values 0.50 of value of standard deviation for change). The changes in the three planning intervention groups were small, and ranged from .80 to 4.40 min for T0–T1 and from −4.40 to 5.07 for T0–T4. The largest change (5.07 min) was observed in target persons participating in the dyadic planning condition.

Changes in MVPA Between Baseline and 1-Week Follow-Up

Target Persons. The results of mixed models analysis showed no Time × Condition interaction effects for target persons' MVPA measured at 1-week follow-up (see Table 2).

Partners. With respect to partners' MVPA changes between T0 and T1, the linear mixed models showed no significant between-group differences (see Table 2).

Changes in MVPA Between Baseline and 36-Week Follow-Up

Target Persons. The results of mixed model-analysis testing the time effect and Time × Condition interactions at 36 weeks showed significant effects (see Table 2). In particular, there was a significant Time × Condition interaction (p = .045) for the dyadic planning condition. Between T0 and T4, target persons in the control condition showed a decrease of −5.07 minutes/day in MVPA (on average), whereas target persons in the dyadic planning condition showed an increase of 5.07 min/day in MVPA (Tables 1 and 2; for simple slopes representing the interaction effect see the online supplemental materials, Figure S2). The observed MVPA change is above the threshold for minimally clinically important difference (see Table 1).

When analyses were repeated controlling for further covariates (economic status, education, PA intention, the relationship type), similar effects on MVPA were found (see online supplemental materials, Table S2).

Partners. The results of the mixed-models analysis indicated a significant Time × Condition interaction (p = .028) for the dyadic planning condition. Between T0 and T4, partners in the control condition showed a decrease of −4.10 minutes/day in MVPA (on average), whereas partners in the dyadic planning condition showed an increase of 1.29 min/day in MVPA (Tables 1 and 2; for simple slopes representing the interaction effect see the online supplemental materials, Figure S2). The observed MVPA change is above the threshold for minimally clinically important difference (see Table 1).

Sensitivity analyses, controlling for economic status, education, PA intention, and the type for relationship, yielded similar findings (see online supplemental materials, Table S2).

Additional Findings: Effects of the Type of Relationship and Effects on MPA and VPA

Additional analyses for T0–T1 MVPA or T0–T4 MVPA outcomes among both dyadic partners indicated that there were no significant effects of the type of the relationship, no Time × Type of Relationship interaction, and no Time × Condition × Type of Relationship interactions (online supplemental materials, Table S3).

The results of additional analyses conducted for MPA and VPA minutes as separate outcomes indicated significant Time × Condition interactions for the dyadic planning condition: MPA at T0–T1 and

Table 2
Target Persons' and Partners' Multilevel Model Estimates Predicting Moderate-to-Vigorous Physical Activity Over 1 Week and 36 Weeks, With Control Condition as the Reference Group

Indicators included in the model	Moderate-to-vigorous activity at 1-week follow-up						Moderate-to-vigorous activity at 36-week follow-up					
	Target persons			Partners			Target persons			Partners		
	Est (*SE*)	*p*	CI_{95} [Lower, Upper]	Est (*SE*)	*p*	CI_{95} [Lower, Upper]	Est (*SE*)	*p*	CI_{95} [Lower, Upper]	Est (*SE*)	*p*	CI_{95} [Lower, Upper]
Intercept[a] (Control condition)	**76.51 (3.75)**	**<.001**	**[69.14, 83.88]**	**85.15 (4.05)**	**<.001**	**[77.19, 93.11]**	**75.15 (3.53)**	**<.001**	**[68.21, 82.10]**	**84.76 (3.81)**	**<.001**	**[77.26, 92.26]**
Time	−1.69 (2.43)	.487	[−6.46, 3.09]	0.15 (2.64)	.955	[−5.04, 5.34]	−0.14 (0.09)	.124	[−0.33, 0.04]	**−0.20 (0.09)**	**.030**	**[−0.37, −0.02]**
Collaborative planning condition	−4.38 (5.00)	.381	[−14.21, 5.45]	−8.15 (5.36)	.129	[−18.69, 2.39]	−2.55 (4.73)	.590	[−11.86, 6.75]	−7.04 (5.06)	.165	[−16.99, −2.91]
Dyadic planning condition	**−11.13 (4.91)**	**.024**	**[−20.79, −1.47]**	−2.75 (5.27)	.602	[−13.12, 7.62]	*−8.15 (4.64)*	*.080*	*[−17.29, 0.98]*	−2.70 (4.98)	.588	[−12.51, 7.11]
Individual planning condition	−4.19 (4.97)	.399	[−13.96, 5.57]	−1.83 (5.34)	.733	[−12.32, 8.67]	−2.45 (4.68)	.601	[−11.66, 6.76]	0.50 (5.01)	.920	[−9.35, 10.35]
Time × Collaborative Planning Condition	4.40 (3.38)	.195	[−2.26, 11.05]	2.97 (3.64)	.415	[−4.20, 10.14]	0.22 (0.13)	.104	[−0.04, 0.48]	0.05 (0.13)	.678	[−0.20, 0.31]
Time × Dyadic Planning Condition	*5.70 (3.33)*	*.088*	*[−0.85, 12.25]*	0.48 (3.60)	.894	[−6.62, 7.57]	**0.26 (0.13)**	**.045**	**[0.01, 0.51]**	**0.27 (0.12)**	**.028**	**[0.03, 0.52]**
Time × Individual Planning Condition	3.81 (3.35)	.256	[−2.78, 10.40]	4.71 (3.63)	.195	[−2.43, 11.85]	0.06 (0.13)	.673	[−0.20, 0.32]	0.14 (0.13)	.278	[−0.11, 0.39]
Age	**−0.44 (0.10)**	**<.001**	**[−0.64, −0.24]**	**−0.37 (0.11)**	**.001**	**[−0.60, −0.14]**	**−0.38 (0.10)**	**<.001**	**[−0.57, −0.18]**	**−0.31 (0.11)**	**.005**	**[−0.52, −0.09]**
Gender	4.69 (3.56)	.188	[−2.31, 11.68]	−0.91 (3.64)	.803	[−8.08, 6.26]	*6.36 (3.34)*	*.058*	*[−0.22, 12.93]*	0.88 (3.47)	.800	[−5.94, 7.70]
BMI	*−0.54 (0.28)*	*.052*	*[−1.09, 0.01]*	0.24 (0.41)	.562	[−0.56, 1.03]	**−0.52 (0.26)**	**.048**	**[−1.03, <0.00]**	0.05 (0.39)	.888	[−0.71, 0.82]
Random effects[a]												
Intercept	**698.02 (66.28)**	**<.001**	**[579.48, 840.81]**	**795.97 (76.06)**	**<.001**	**[660.03, 959.92]**	**738.61 (70.17)**	**<.001**	**[613.13, 889.77]**	**716.38 (101.44)**	**<.001**	**[542.77, 945.52]**
Time							**0.36 (0.06)**	**<.001**	**[0.26, 0.50]**	**0.20 (0.06)**	**<.001**	**[0.12, 0.36]**
Intercept × Time							**−5.33 (1.49)**	**<.001**	**[−8.25, −2.41]**	*−3.02 (1.58)*	*.056*	*[−6.10, 0.07]*
Residual variance	**195.77 (16.49)**	**<.001**	**[165.98, 230.92]**	**225.21 (19.13)**	**<.001**	**[190.67, 266.01]**	**160.74 (25.66)**	**<.001**	**[117.56, 219.78]**	**307.79 (70.25)**	**<.001**	**[196.77, 481.43]**

Note. 1-week follow-up = change between Time 0 and Time 1; 36-week follow-up = change between Time 0 and Time 4; Intercept = baseline accelerometry assessment in control condition; Time = change over time in reference group; Est = estimate; CI_{95} = Lower and Upper levels of 95% Confidence Interval; BMI = body mass index; MVPA = moderate-to-vigorous physical activity. For sample sizes at each measurement point see Figure 1. All analyses were controlled for covariates: age, gender: 1 = men, 0 = women, and BMI. Bold coefficients represent significant relationships. Coefficients in italics represent statistical trends ($p < .10$). For target persons' MVPA up to the 1-week follow-up: true R^2 = .10; for target persons' MVPA up to the 36-week follow-up: true R^2 = .08; for partners' MVPA up to the 1-week follow-up: true R^2 = .05; for partners' MVPA up to the 36-week follow-up: true R^2 = .04.
[a] = for 1-week follow up models: random intercept and fixed effects of other predictors were modeled; for 36-week follow-up: random intercept and time, and fixed effects of other predictors were modeled.

VPA at T0–T4 among target persons; MPA at T0-T4 for partners, all *p*s $< .039$ (see online supplemental materials, Tables S6 and S7).

Discussion

This randomized controlled trial showed that compared to the control condition, target persons and partners involved in dyadic planning improved their MVPA minutes at 36-week follow-up (i.e., 6 months after the last intervention session was delivered). The effects of dyadic planning on MVPA up to the 36-week follow-up were small, but they may be considered to meet the threshold for a minimally clinically important difference (Norman et al., 2003). Small changes in MVPA, particularly for those below international physical activity guidelines, may result in health benefits (Warburton & Bredin, 2019).

At first glance, our findings may seem to be in contrast to previous research on planning. A study using accelerometer-based MVPA indicators showed that dyadic planning did not improve target persons' and partners' PA, compared to individual planning or control conditions (Knoll et al., 2017), whereas a study using self-reported MVPA evaluations showed that target persons taking part in collaborative planning outperformed those in control and individual planning conditions (Prestwich et al., 2012). Juxtaposing findings from previous studies and the present study, it should be highlighted that there are substantial differences in intervention procedures and outcome assessment. Knoll et al. (2017) relied on one intervention session only, whereas the present study included three face-to-face sessions and four phone-based boosters of planning. Booster sessions may result in improved behavioral effects, compared to a single session as shown in research on planning (Chapman & Armitage, 2010; Scholz et al., 2013). On the other hand, adding 20 booster sessions of individual planning may result in similar changes in PA to those found among people enrolled into a complex standard care (Knäuper et al., 2018). The improvement of MVPA among participants involved in collaborative planning, reported by Prestwich et al. (2012), referred to a number of 10-minute bouts of any PA (including light-intensity PA), performed by target persons. However, when the outcome was assessed with METs levels (METs strongly depend on MVPA, much less on light PA), collaborative planning was no longer superior to individual planning or control conditions (Prestwich et al., 2012). Besides the actual active components of interventions (i.e., planning), differences in the outcome assessment and implementation procedures may affect the findings (Luszczynska, 2020).

Social systems are helpful to enact behavior change (Rothman et al., 2020). Dyadic planning involves social exchange processes, such as provision and receipt of social support, social control, modeling, rewarding, and so forth (Berli et al., 2018; Burkert et al., 2011; J. Keller et al., 2020; Knoll et al., 2017). It was developed in the context of coping with a chronic illness by a target person and their partner (Burkert et al., 2011), and assumes distinct roles within the dyad, with partner efforts focused on supporting the action of the target person. Besides a behavior change of the target person (Burkert et al., 2011; Knoll et al., 2017), partner's behavior change may also occur, as a result of partners merely observing and/or supporting the process of behavior change of the target person (Berli et al., 2018).

In our study, target persons (compared to partners) were less frequently adhering to WHO (2010) guidelines on PA before being enrolled in this study, more frequently had type II diabetes, cardiovascular diseases, or overweight/obesity. It is possible that due to behavioral and health inequality, the roles of the target person and the partner (in the context of health behavior change) were already self-assigned by the dyads themselves before the study enrollment, and such self-assigned roles were maintained across experimental conditions. In line with the communal coping approach (Helgeson et al., 2018) it may be assumed that dyadic partners were already involved in collaborating to manage an illness or a process of PA change prior to the study.

Dyadic planning procedures relied on dyads actively self-assigning the roles of target persons and partners, whereas other conditions did not refer to these self-assigned roles. The structural context, including the health status, the type of relationship, or the roles within the relationship may determine the effects of a behavior change intervention (Rothman et al., 2020). Dyadic interventions might represent a better match for the structural context, when enrolled participants include dyads with self-defined roles of "the patient/target person" and "the supporting partner." Unfortunately, the match–mismatch of the roles of "the target person" and "the partner" was not assessed in a systematic manner. Future dyadic research may further investigate if the roles assumed in dyadic planning match the roles the partners assign to themselves, in the context of the specific goal pursuit.

Our study is among the first showing that dyadic planning may result in a small but minimally clinically important changes in MVPA. As such, the study make an essential step forward in developing complex interventions. The results help to make an evidence-based decision of adding dyadic planning as a component of a complex MVPA change program, incorporating other behavior change techniques (Michie et al., 2013). Adding dyadic planning to complex interventions may take a precedence over including individual planning, which is often considered a default form of planning (Hagger et al., 2016).

Besides its strengths, the present study has several limitations. Existing evidence and theoretical development provided an insufficient backdrop for formulating specific hypotheses, assuming superiority of a specific type of planning in terms of its effects on target persons' or partners' MVPA. This RCT has some deviations from the recommended standards, such as reliance on simple randomization, randomization after checking for the inclusion criteria but prior to the baseline MVPA assessment, and a failure to blind outcome assessors (although, less observer bias may be assumed when the "objective" outcome, such as accelerometer-assessed MVPA, is considered). T0 assessment showed that participants already engaged in a substantial number of MVPA minutes in the week after the first PA self-report. This may represent the "question–behavior" effect (i.e., self-report on PA, conducted at T0 might induce PA changes across the groups; Wilding et al., 2019), or occur due to increased awareness of own MVPA induced by wearing the accelerometer, or result from moving to the postintentional phase (Schwarzer & Luszczynska, 2015) after making a decision to join this complex behavior change intervention. Relatively high levels of MVPA at T0 could reduce a chance for further improvement across the study groups. Lower baseline MVPA levels could be expected if instead of a community sample, the participating dyads would include people with type II diabetes solely (Wooldridge et al., 2019). The underlying mechanisms, including self-regulatory and social processes, were not investigated, therefore the causes of differences in the efficiency of the three types of planning interventions remain hypothetical. The sample size allowed for detecting medium-size effects, whereas the long-term effects of individual planning may be small-to-medium (Bélanger-Gravel et al., 2013). The sample was heterogeneous in terms of health status, BMI, socioeconomic status, the type of relationship, and so forth. Although several of these context variables were controlled in sensitivity analyses, they may also actively codetermine the efficacy of intervention techniques. Future research should investigate the potential interaction effects of the type of relationship on the MVPA changes over time. The diagnosis of a disease was self-reported and there was no assessment of symptom severity. Future research should control for disease-specific factors as the potential source of heterogeneity of the sample, and respectively, the heterogeneity of obtained findings. The majority of participants were women and people with higher education, which limits any generalizations. The findings cannot be generalized to individuals with weak intention to exercise. The partners reported relatively strong intentions to improve their own PA: having a partner with a shared goal of increasing PA may facilitate achieving this goal in both dyadic partners (Helgeson et al., 2018). The observed effects were small and their impact on health requires further evaluation.

Concluding, this randomized controlled trial provides a novel insight into the efficacy of collaborative, dyadic, and individual planning interventions. Among target persons and their partners, dyadic planning was related to beneficial long-term changes (36-week follow-up, 6 months after the final intervention session) in accelerometer-measured MVPA. In dyads including adults from the general population, with at least one person who does not adhere to PA guidelines at the baseline or has a cardiovascular disease/type II diabetes, dyadic planning may be a preferred choice to improve MVPA levels in both dyadic members.

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Artykuł 2: Insight into Effects of Individual, Dyadic, and Collaborative Planning Interventions on Automatic, Conscious, and Social Process Variables

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Insights into effects of individual, dyadic, and collaborative planning interventions on automatic, conscious, and social process variables

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A R T I C L E I N F O

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A B S T R A C T

Objective: Going beyond the effects of individual planning ("I-for-me"), we investigate the associations of dyadic ("we-for-me") and collaborative ("we-for-us") planning with automatic, conscious, and social process variables that may elucidate the differences through which these three types of planning operate. We tested the effects of three planning interventions on: (1) habit strength, representing an automatic process, (2) the use of individual planning, representing a conscious process, (3) the use of collaborative planning, representing conscious and social processes, and (4) collaborative social control, representing a social process.

Methods: $N = 320$ adults were randomly assigned to one of four conditions: (1) the active control condition, (2) the individual planning condition, (3) the dyadic planning condition, or (4) the collaborative planning condition. Self-reported data on habit strength, the use of individual planning, the use of collaborative planning, and collaborative social control were assessed at baseline and at the 9-week follow-up. Analyses used linear mixed modelling.

Results: Compared to the control group, participants in the individual planning condition had stronger habits at the 9-week follow-up. Those in the dyadic planning condition reported higher levels of the use of collaborative planning and higher levels of collaborative social control at the follow-up. Finally, compared to those assigned to the control group, participants in the collaborative planning condition reported stronger habits, higher levels of the use of both individual and collaborative planning, and higher levels of collaborative social control at the follow-up.

Conclusions: Individual, dyadic, and collaborative planning interventions may result in distinct patterns of changes in the variables representing automatic, conscious, and social processes. In particular, changes in automatic, conscious and social process variables, evoked by the collaborative "we-for-us" planning intervention may reflect the major regulatory effort of forming joint plans and subsequently integrating regular joint exercise into the weekly schedule.

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1. Introduction

The self-regulatory strategy of planning one's own behavior has been studied as a correlate or a determinant of health behavior change for over 30 years. Individual planning is an essential component of several theoretical approaches explaining health behavior change, including the implementation intentions framework (Bieleke et al., 2021; Prestwich et al., 2015) and the health action process approach (HAPA; Schwarzer and Luszczynska, 2015). Implementation intentions are typically operationalized as a link between situation and goal-oriented action: "If situation X is encountered, then I will perform response Y" (Gollwitzer, 1999). In turn, individual action planning links desired behaviors with characteristics of future situations, such as time and location (Hagger and Luszczynska, 2014). Individual coping planning refers to identifying potential barriers and ways to overcome these barriers (Hagger and Luszczynska, 2014; Hagger et al., 2016). Individual planning has attracted a lot of attention as a strategy linked to behaviors such as physical activity (PA), nutrition, smoking cessation, or alcohol use, with meta-analyses yielding small-to-medium effect sizes (Malaguti et al., 2020; McWilliams et al., 2019; Zhang et al., 2019).

How does individual planning work? In line with dual-process frameworks (Hagger and Hamilton, 2020; Strack and Deutsch, 2004), two main hypotheses assume that forming individual plans affects automatic and conscious processes. The first type of process refers to automaticity of behavior: planning creates a strong associative link between the characteristics of the critical situation and the behavioral response, allowing people to automatically initiate the planned behavior when the respective critical situation arises (Bieleke et al., 2021; Gardner et al., 2012; Gardner and Lally, 2018). This automatic process is represented by habit strength (Bieleke et al., 2021; Gardner et al., 2012; Gardner and Lally, 2018). Research has supported that planning and forming individual implementation intentions may affect habit strength (Judah et al., 2020; Verplanken and Orbell, 2019). For example, individual PA planning predicts stronger PA habits (Schwarzer et al., 2018).

According to an alternative hypothesis, individual planning may result in a stronger involvement in the deliberate, conscious process of decision-making and self-evaluation (Hagger and Luszczynska, 2014; Prestwich et al., 2015). Individual planning may trigger an increase of the regular use of planning, applied as a self-regulatory strategy in the management of complex behaviors and complex environments. For example, individual planning interventions were found to influence the use of planning, which in turn predicted change in PA (Keller et al., 2021; Luszczynska et al., 2016).

The individual approach to planning disregards the fact that planning and health behavior change processes often occur in a social context (Hagger et al., 2016; Rhodes et al., 2020). Approaches accounting for cognitions and behaviors of partners, family members, or friends of individuals who intend to change their behavior may help to better understand behavior change (Rhodes et al., 2020; Scholz et al., 2020). Two approaches extend the individual "I-for-me" planning concept to account for the social context: these are dyadic planning (Burkert et al., 2011) and collaborative planning (Prestwich et al., 2012). In the dyadic "we-for-me" planning, a focus person plans their own future behavior and the main role of their partner is to assist in the plan formation (Burkert et al., 2011; Keller et al., 2020; Knoll et al., 2017). Collaborative "we-for-us" planning occurs when a focus person and their partner form plans together, and the plans refer to joint behavioral enactment (Prestwich et al., 2012).

Research has provided evidence for the effects of planning interventions on the changes in the frequency of the use of dyadic planning. Specifically, compared to a control condition, taking part in either dyadic or individual PA planning determined short-term increases in the use of dyadic planning, yet these effects were not maintained over longer periods (Keller et al., 2020). Short-term effects of a dyadic planning intervention on the use of dyadic planning were also found in the context of pelvic floor exercise uptake among prostate cancer patients (Burkert et al., 2011). In contrast to research on the use of individual and dyadic planning, the influence of planning interventions on the use of collaborative planning has not been tested.

Consistent with models of dyadic interactions in health contexts such as the systemic transactional model (Bodenmann, 1997), the congruence model (Revenson, 1994), or the relationship-focused model (O'Brien and DeLongis, 1996), it may be assumed that dyadic or collaborative planning may affect social process variables, such as social control or social support (Keller et al., 2020; Knoll et al., 2017; Prestwich et al., 2012, 2014). Social control may be defined as any attempt by one partner to influence the other partner's health or health behaviors, assuming that interactions involving social control are independent of affirmation or provision of resources (Lewis and Rook, 1999). Social control predominantly focuses on evoking a change in the other person's behavior (Lewis and Rook, 1999). The use of positive reinforcements of a desired behavior may be an example of positive social control whereas attempts to induce negative emotions in response to an undesired behavior may refer to negative social control (Lewis and Butterfield, 2007). Effects of positive and negative social control have been studied extensively in longitudinal correlational studies conducted in dyads with the focus person attempting to improve their PA (Berli et al., 2018; Scholz et al., 2021). Scholz et al. (2021) concluded that positive and negative control cannot be unanimously recommended as a behavior change strategy in romantic dyads. Similar conclusions have been drawn by Berli et al. (2018).

Experimental evidence for the role of social process variables, accumulated to date in the context of planning and PA, is ambiguous. For example, research on dyadic planning found that participating in either dyadic or individual planning interventions resulted in short-term increases of social support, yet these effects became non-significant over longer periods (Keller et al., 2020). Further, the dyadic planning intervention did not influence received social control, referring to the partners' use of social pressure (Keller et al., 2020). Other research, however, has shown that taking part in a collaborative PA planning intervention resulted in higher levels of perceived social control compared to a control condition, up to 3 months post-intervention (Prestwich et al., 2012).

Besides positive and negative social control, a third type of social control was proposed to explain PA in the social context (Wilson et al., 2010). This strategy, named collaborative control, reflects using social influence tactics by the dyadic partner, such as offering to be active with the focus person, offering to participate in PA so the focus person could observe it, and helping the focus person to learn the skills needed to be active (Wilson and Spink, 2010). Research conducted in the context of PA showed that adolescents' perceptions and parental perceptions of the use of collaborative social control by parents were related to the PA of adolescents and children (Liszewska et al., 2018; Wilson and Spink, 2010).

Although the evidence for the effects of individual, dyadic, and collaborative planning interventions on automatic, conscious, and social process variables is accumulating (Keller et al., 2020; Knoll et al., 2017; Prestwich et al., 2012; Prestwich et al., 2014; Verplanken and Orbell, 2019), some questions remain unanswered. First, the effects of planning on habit strength have only been tested in the context of individual planning interventions (Bieleke et al., 2021; Verplanken and Orbell, 2019). The effects of dyadic and collaborative planning interventions on habit strength are unknown and require further research. It is important to test if effects of an individual planning intervention on habit strength generalizes to other types of planning interventions. Further, it seems possible that a collaborative planning intervention, where two people form plans about their joint behaviors, may make it more difficult to create the automatic plan-cue-behavior link because accommodating another person's schedule and preferences may require the use of conscious processes and social influence strategies. These assumptions have not been tested. The effects of planning interventions on the subsequent use of individual and dyadic planning have been studied (e.g., Keller et al., 2020; Luszczynska et al., 2007), yet the influence of planning interventions on the subsequent use of collaborative planning remains unknown. Finally, although the effects of the planning interventions on social support and negative social control have been tested in past research (Keller et al., 2020; Knoll et al., 2017; Prestwich et al., 2012, 2014), the influence of dyadic and collaborative interventions on collaborative social control strategies remains unknown and requires further clarification.

To advance these past limitations, this study tested if taking part in an individual, dyadic, or collaborative planning intervention would affect: (1) habit strength, (2) the use of individual planning, (3) the use of collaborative planning, and (4) collaborative social control. In particular, we hypothesized that the individual planning intervention would have an effect on habit strength (an automatic process). In contrast, we hypothesized that dyadic and collaborative planning interventions may influence (1) conscious process variables, such as individual planning, and (2) social process variables, such as the use of collaborative planning and collaborative social control. The effects observed in the three experimental goups were compared with the changes in the control condition at 9-weeks after the baseline.

2. Method

2.1. Design

This study reports secondary outcomes of a randomized controlled trial (RCT), registered at ClinicalTrials.gov (#NCT03011385). The findings for the main registered outcome, moderate-to-vigorous physical activity (MVPA) indicated that dyadic planning, but not collaborative or individual planning influenced accelerometer-measured MVPA at 36 weeks after the baseline (Kulis et al., 2022). In contrast, the findings for sedentary behavior (SB) time yielded short-term effects of collaborative planning (Szczuka et al., 2021). The present study investigates data obtained from the focus persons only (i.e., individuals who were the main intervention target), whereas their partners supported the process of MVPA change.

2.2. Participants

At Time 0 (T0), $N = 320$ adult participants were enrolled. The participant flow is presented in Supplemental Materials, Fig. S1. Participants' mean age was 43.86 years ($SD = 17.02$; range: 18–90), 64.4% were women. The average body mass index (BMI) was 28.02 ($SD = 6.41$), and 62.2% were overweight or obese. All participants were white, as is 99% of the population of Poland. Most participants were in a romantic relationship (79%). Education and economic status, as well as participants' characteristics across the four study groups, are provided in Supplemental Materials (Table S1).

The inclusion criterion was being insufficiently physically active, specifically not meeting the World Health Organization (2020, 2020) recommendations of at least 150 min of MVPA per week and/or being recommended by a specialist to increase the number of MVPA minutes per week due to a chronic illness (e.g. a cardiovascular disease). As self-reported at the T0 measurement, 87.8% did not meet the PA guidelines (World Health Organization, 2010; 2020). Overall, 39.4% reported cardiovascular disease and/or type-2 diabetes; other chronic illnesses were reported by 27.2% of participants.

2.3. Procedures

For the purpose of this study, we focused on self-reported habit strength, the use of individual and collaborative planning, and collaborative social control, assessed at T0 and at Time 3 (T3) which took place at 9 weeks after T0 and 4 weeks after the fourth booster session. The three types of planning interventions vs. active control procedures were introduced at T1 (1 week after T0), repeated in-person at T2 (2 weeks after T0), followed by three weakly booster calls (3 consecutive weeks after T2) repeating intervention procedures. Respective details of the study procedures are presented in Supplemental Materials, Fig. S2 and in the study protocol, see Open Science Framework (https://osf.io/68gp2/).

Data were collected between February 2016 and February 2020. The study was conducted in 25 urban and 7 rural locations in South-West, Central, and Northern Poland ($N = 6$ regions) by 38 trained experimenters. The training consisted of at least 2 preparatory sessions prior to the study and a regular supervision. Each face-to-face meeting was set at locations agreed upon by the participants and the research team. After each face-to-face session, participants received small gifts with an average value of up to 10 EUR. The study was approved by the Ethics Committee at SWPS University, Wroclaw, Poland. Procedures were conducted in accordance with the 1964 Helsinki declaration and its later amendments. Informed consents were collected. All data were coded to secure anonymity.

2.4. Randomization and blinding

After assessment of inclusion criteria at T0, participants and their partners were randomly assigned to one of four experimental conditions: individual ($n = 82$), dyadic ($n = 83$), or collaborative ($n = 79$) planning conditions, or the active control group ($n = 76$) (Fig. S2, Supplemental Materials). The randomization was conducted using a random digit generator and was not stratified. The researcher conducting randomization was blinded to the dyad enrollment and the intervention assignment.

2.5. Intervention and control group procedures

Detailed description of the delivery and the content of the intervention and control procedures is presented in Supplemental Materials. In the active control condition, participants were introduced to a healthy nutrition education at T0, followed by PA, and SB education at T1 and T2. All education procedures included respective guidelines, recommendations, and simple tips for behavioral enactment. A brief reminder of this information was provided during booster calls.

In the individual planning condition, the education session took place at T0, T1, T2, and during the booster calls. At T1 and T2, both members of the dyad wrote down specific action plans about "when," "where," and "how" they were going to be physically active within the following 7 days (Luszczynska et al., 2007; see also Knäuper et al., 2018), followed by coping plans, "if situation X appears then you will cope with it by doing Y" (Sniehotta et al., 2006). The respective individual planning procedures were repeated during the three booster calls.

In the dyadic planning condition, education sessions delivered at T0, T1, T2, and during the booster calls, were followed by T1 and T2 planning sessions: participants formed specific dyadic action plans about "when," "where," and "how" the focus person would be physically active followed by dyadic coping plans. In contrast to individual planning, during the dyadic planning sessions partners actively supported the focus persons' plan formation (Knoll et al., 2017). During booster calls participants were encouraged to make specific dyadic action and dyadic coping plans.

Finally, in the collaborative planning condition, education sessions delivered at T0, T1, T2, and during the booster calls, were followed by T1 and T2 planning sessions. Partners and participants discussed their joint plans and wrote down specific collaborative action plans about "when," "where," and "how" to be physically active together (Prestwich et al., 2012) and collaborative coping plans. During booster calls participants were asked to form collaborative plans with their partners.

2.6. Measures

Descriptive statistics for habit strength, the use of individual and collaborative planning, and collaborative social control measures are reported in Table 1.

2.6.1. Habit strength (T0, T3)

PA habit strength was measured with two items from Gardner et al. (2012): "Physical activity is something I do automatically/I do without thinking," "Physical activity is something I do without having to consciously remember it." The responses ranged from 1 = *definitely not* to 4 = *definitely yes*. The two items were correlated at T0, $r = 0.77$, $p < .001$, and at T3, $r = 0.78$, $p < .001$.

2.6.2. The use of individual planning (T0, T3)

The self-reported use of individual planning was assessed with four items (Luszczynska et al., 2007), "During the last week, I have formed my own plans regarding: (a) when to exercise, (b) where to exercise, (c) which exercises I will perform, and (d) how frequent to exercise." The responses ranged from 1 = *definitely not* to 4 = *definitely yes.* The internal consistency of the scale was high at T0, α = 0.96, and at T3, α = 0.97.

2.6.3. The use of collaborative planning (T0, T3)

The self-reported use of collaborative planning was assessed with three items, adopted from Luszczynska et al. (2007): "During the last week, my partner and I have formed joint plans regarding (a) when to exercise together, (b) how frequently to exercise together, and (c) which exercises we will perform together." The responses ranged from 1 = *definitely not* to 4 = *definitely yes.* The internal consistency of the scale was high, with α = 0.97 at T0, and α = 0.98 at T3.

2.6.4. Collaborative social control (T0, T3)

Collaborative social control was measured with two items from Wilson et al. (2010), "My partner prompts me to learn new skills that I use in sports or exercise" and "My partner participated in exercise him/herself so I could observe him/her." The scale reflects perceptions of participants regarding the use of collaborative social control by their partners. The responses ranged from 1 = *never* to 4 = *always*. The items were correlated at T0, $r = 0.71$, $p < .001$, and at T3, $r = 0.63$, $p < .001$.

2.6.5. Control variables (T0)

Baseline MVPA minutes per day were assessed by ActiGraph wGT3X-BT accelerometers. Valid data consisted of 3–6 consecutive days, with a minimum of 8 h per day of wearing the accelerometer on the right hip (Prescott et al., 2020). The Sasaki et al. (2011) algorithm was used to count MVPA in minutes per day. Daily minutes of MVPA for each valid wear day were summed up and divided by the number of valid wear days ($M = 73.47$, $SD = 30.57$). Univariate outliers ($z > |3.29|$) were winsorized to one unit lower/higher than the next highest or lowest value in the distribution, respectively. Data obtained during the first valid wear day at T0 were excluded.

PA intention was measured with two items (Maher and Conroy, 2015), e.g., "I intend to engage in several 30-min bouts of moderate physical activity in the next week." The responses ranged from 1 = *definitely not* to 4 = *definitely yes*. The two items were moderately correlated, with $r = 0.57$, $p < .001$ at T0.

Body weight and height were assessed with a telescopic height measuring rods and floor scales (BF-18 or BF-530; Beurer, Germany).

Sociodemographic variables assessed at T0 included participants' age and gender, education (ranging from 1 = *primary school only* to 4 = *a university degree*), perceived economic status ("Compared with the average economic status of families in the country, how would you rate the economic status of your family?"; the responses ranged from 1 =

Table 1
Participants' habit strength, the use of individual planning, the use of collaborative planning, and collaborative social control: Descriptive statistics, within-group differences, effects sizes, and intraclass correlation coefficients.

Indicators		Individual planning condition (n = 82)	Dyadic planning condition (n = 83)	Collaborative planning condition (n = 79)	Control condition (n = 76)	Total (n = 320)
		M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Habit strength	T0	2.09 (0.90)	2.09 (0.88)	2.06 (0.88)	2.33 (0.84)	2.14 (0.88)
	T3	2.61 (0.71)	2.55 (0.70)	2.59 (0.85)	2.53 (0.75)	2.57 (0.75)
	d_{ppc2} effect size coefficient (between experimental and control groups)	0.37	0.30	0.38		
	ICC	0.44	0.35	0.38	0.38	0.39
The use of individual planning	T0	2.43 (0.92)	2.30 (0.91)	2.24 (0.98)	2.46 (0.90)	2.35 (0.93)
	T3	2.74 (0.80)	2.68 (0.68)	2.85 (0.76)	2.68 (0.72)	2.73 (0.74)
	d_{ppc2} effect size coefficient (between experimental and control groups)	0.10	0.18	0.41		
	ICC	0.48	0.38	0.31	0.44	0.36
The use of collaborative planning	T0	1.88 (0.89)	1.69 (0.82)	1.84 (0.90)	1.93 (0.77)	1.83 (0.85)
	T3	1.93 (0.82)	1.92 (0.76)	2.36 (0.90)	1.79 (0.78)	2.00 (0.84)
	d_{ppc2} effect size coefficient (between experimental and control groups)	0.23	0.46	0.78		
	ICC	0.66	0.29	0.38	0.38	0.41
Collaborative social control	T0	1.81 (0.91)	1.82 (0.86)	1.95 (0.94)	1.93 (0.89)	1.88 (0.90)
	T3	2.03 (0.85)	2.12 (0.76)	2.27 (0.82)	1.89 (0.81)	2.08 (0.82)
	d_{ppc2} effect size coefficient (between experimental and control groups)	0.29	0.39	0.39		
	ICC	0.47	0.45	0.47	0.39	0.44

Note. T0 = baseline; T3 = 9-week follow-up; ICC = Intraclass correlation coefficient; PA = physical activity. d_{ppc2} effect size coefficient (between experimental and control groups): the coefficient for repeated measures designs, weighting for the difference of the pre-post sample sizes, per-post means, and standard deviations in both the respective experimental group and the control group (Morris, 2008). For sample sizes at each measurement point see Supplemental Materials 1, Fig. S1.

much below the average to 5 = *much above the average*), and the type of relationship with a partner involved in the planning sessions or the control condition sessions (1 = romantic; 0 = other).

2.7. Data analysis

Linear mixed models (IBM SPSS 26) were used to model habit strength, the use of individual and collaborative planning, and collaborative social control at the 9-week follow-up. Only 5.63% data were missing in the main analyses conducted for habit strength as the outcome variable, 5.16% were missing in the analyses conducted with individual planning as the outcome, 5.16% were missing in the analyses conducted for the use of collaborative planning as the outcome, and 5.31% of data were missing in the analyses conducted for collaborative social control as the outcome. The full information maximum likelihood method was used to account for all missing data in the analyses.

Assuming a power of .95, an alpha of .05, four experimental conditions, the effects of potential confounders, and small to medium effect sizes of $\varsigma^2 = 0.10$ (Keller et al., 2020; Luszczynska et al., 2007) the minimum sample size for analyses was 285 participants. The sample sizes were calculated with the G*Power calculator.

To examine between-condition differences of participants' dependent variables, we modelled three dummy-coded planning conditions as predictors, with the control condition as the reference group. To model effects over time, a time variable was included as a predictor, with the following coding: "0" for baseline (T0) and "9" for the 9-week follow-up (T3). Interactions between time and the three planning conditions were added as predictors. Random effects of time and intercepts were specified. Because the models conducted with random time effects did not converge, random time effects were excluded from all equations.

Sensitivity analyses were controlled for grand-mean centered age, BMI, PA intention, economic status, education, MVPA at T0, gender ("1" - male, "0" - female), and the type of relationship ("1" - romantic, "0" - other). Additional sensitivity analyses were modelled to test changes over time in the outcome variables with a list-wise deletion approach to the missing data. Finally, we tested the patterns of changes in the models with individual and dyadic planning conditions as reference groups.

The true R^2, representing the squared correlation between the actual outcome and the outcome predicted by the fixed effects, was computed to estimate the size of total effects (Hoffman, 2015). In addition, d_{ppc2} effect sizes were calculated to compare each of the three experimental groups with the control group. This coefficient was developed for repeated measures designs, weighting for the difference of the pre-post sample sizes, means, and standard deviations in both the experimental group and the control group (Morris, 2008).

Data files, syntaxes, and outputs for the main analyses are available at the Open Science Framework (https://osf.io/68gp2/).

3. Results

3.1. Preliminary results: Attrition patterns, randomization checks, and correlations

Attrition analyses indicated that participants who dropped out after T0 did not differ from completers in terms of baseline assessments of age, gender, economic status, education, BMI, the type of relationship, PA intention, MVPA, habit strength, the use of individual and collaborative planning, and collaborative social control (all $Fs < 1.87$, all $ps > .172$ and all $\chi s^2 < 1.49$, all $ps > .222$; see Supplemental Materials). Missing data for age, gender, BMI, education, economic status, PA intention, the type of relationship, MVPA, habit strength, the use of individual and collaborative planning, and collaborative social control were missing completely at random, Little's MCARχ^2 (223) = 242.84, p = .173.

Randomization checks indicated no between-condition differences at T0 for age, gender, economic status, education, the type of relationship, PA intention, BMI, MVPA, habit strength, the use of individual and collaborative planning, and collaborative social control (all $Fs < 1.59$, all $ps > .193$ and all $\chi s^2 < 6.79$, all $ps > .079$; see Supplemental Materials).

Across and within measurement points, the associations between the use of individual and collaborative planning were either non-significant or significant but weak, with *r*s ranging from 0.04 to 0.23 (see Table S3 Supplemental Materials). The associations between collaborative social control and the use of individual planning were weak, with *r*s ranging from 0.11 to 0.28. The associations between collaborative social control and the use of collaborative planning were in the medium to large range, with *r*s ranging from 0.32 to 0.68. Moreover, associations between habit strength and the use of individual planning ranged from 0.17 to 0.38. Finally, the associations between habit strength and the use of collaborative planning were all weak, with *r*s ranging from 0.07 to 0.20 (Table S3, Supplemental Materials).

3.2. Effects of three types of planning interventions on habit strength

We found a significant Time x Individual planning condition interaction (p = .020) and a significant Time x Collaborative planning condition interaction (p = .019), explaining habit strength measured at T3 (Table 2). These interactions were obtained when the two planning conditions were contrasted with the active control condition. Considering T0 to T3 changes in habit strength, participants in the control condition showed an increase of 0.20 points of habit strength (on average; using a response scale of 1–4), whereas participants in the individual and collaborative planning conditions showed increases of 0.52 and 0.53, respectively (Tables 1 and 2). The values of the d_{ppc2} coefficient suggested medium sized effects, with d_{ppc2} of 0.37 and 0.38, for the individual and collaborative planning conditions, respectively, compared to the control condition (Table 1). Habit strength was not affected by the participation in the dyadic planning condition (Table 2), as indicated by a non-significant Time x Dyadic planning condition interaction.

Additional analyses, conducted with either the individual or the dyadic planning condition as the reference groups indicated no further significant Time × Condition interactions (see Supplemental Materials). Sensitivity analyses, controlling for age, gender, economic status, education, BMI, PA intention, MVPA at T0, and the type of relationship (Table S2, Supplemental Materials) and applying a list-wise deletion as an alternative missing data treatment (Table S4, Supplemental Materials) yielded results similar to those obtained in the main analyses, presented in Table 2.

3.3. Effects of three types of planning interventions on the use of individual planning

The results of the mixed model analysis (Table 2) showed significant interactions of the Time x Collaborative planning condition (p = .009) in models explaining the use of individual planning at T3 as the outcome variable. Considering T0 to T3 changes in the use of individual planning, participants in the control condition showed an increase of 0.22 points (on average; response scale ranging from 1 to 4), whereas participants in the collaborative planning condition showed an increase of 0.61 points (Tables 1 and 2). The $d_{ppc2} = 0.41$ coefficient indicated a medium sized effect for the collaborative planning condition, compared to the control condition (Table 1). In contrast to the effects observed in the collaborative planning group, we did not find further significant interactions between time and the other experimental conditions in the groups assigned to the individual or dyadic planning conditions.

Additional analyses, conducted with either individual or the dyadic planning conditions as the reference groups indicated an additional significant Time × Condition interaction. Specifically, the T0 to T3 increases in the use of individual planning was larger in the collaborative planning condition, compared to the changes observed in the individual

Table 2
Participants' multilevel model estimates predicting: Habit strength, the use of individual planning, the use of collaborative planning, and collaborative social control over 9 weeks with the control condition as the reference group.

	Habit strength			The use of individual planning			The use of collaborative planning			Collaborative social control		
	Est *(SE)*	*p*	CI_{95} Lower Upper	Est *(SE)*	*p*	CI_{95} Lower Upper	Est *(SE)*	*p*	CI_{95} Lower Upper	Est *(SE)*	*p*	CI_{95} Lower Upper
Fixed effects[a]	9-week follow-up											
Intercept (Control condition)	**2.33 (0.09)**	< **.001**	**2.14 2.51**	**2.46 (0.10)**	< **.001**	**2.27 2.65**	**1.93 (0.10)**	< **.001**	**1.74 2.11**	**1.93 (0.10)**	< **.001**	**1.74 2.13**
Time	**0.02 (0.01)**	**.039**	< **0.01 0.04**	**0.02 (0.01)**	**.034**	< **0.01 0.05**	−0.02 (0.01)	.169	−0.04 0.01	−0.01 (0.01)	.641	−0.03 0.02
Individual planning condition	*−0.24 (0.13)*	*.065*	*−0.50 0.02*	−0.03 (0.13)	.829	−0.29 0.23	−0.05 (0.13)	.709	−0.31 0.21	−0.12 (0.14)	.372	−0.39 0.15
Dyadic planning condition	*−0.24 (0.13)*	*.071*	*−0.49 0.02*	−0.16 (0.13)	.231	−0.42 0.10	*−0.24 (0.13)*	*.072*	*−0.50 0.02*	−0.11 (0.14)	.398	−0.38 0.15
Collaborative planning condition	**−0.27 (0.13)**	**.039**	**−0.53 −0.01**	−0.22 (0.13)	.105	−0.48 0.05	−0.08 (0.13)	.531	−0.35 0.18	0.02 (0.14)	.912	−0.26 0.29
Time x Individual planning condition	**0.04 (0.02)**	**.020**	**0.01 0.07**	0.01 (0.02)	.557	−0.02 0.04	0.02 (0.02)	.178	−0.01 0.05	*0.03 (0.02)*	*.062*	*>-0.01 0.06*
Time x Dyadic planning condition	*0.03 (0.02)*	*.064*	*>-0.01 0.06*	0.02 (0.02)	.272	−0.01 0.05	**0.04 (0.02)**	**.009**	**0.01 0.07**	**0.04 (0.02)**	**.013**	**0.01 0.07**
Time x Collaborative planning condition	**0.04 (0.02)**	**.019**	**0.01 0.07**	**0.04 (0.02)**	**.009**	**0.01 0.07**	**0.07 (0.02)**	< **.001**	**0.04 0.10**	**0.04 (0.02)**	**.009**	**0.01 0.07**
Random effects[a]												
Intercept	**0.30 (0.04)**	< **.001**	**0.23 0.39**	**0.29 (0.04)**	< **.001**	**0.22 0.39**	**0.30 (0.04)**	< **.001**	**0.23 0.40**	**0.34 (0.05)**	< **.001**	**0.26 0.44**
Residual variance	**0.37 (0.03)**	< **.001**	**0.32 0.43**	**0.42 (0.03)**	< **.001**	**0.36 0.49**	**0.39 (0.03)**	< **.001**	**0.33 0.45**	**0.39 (0.03)**	< **.001**	**0.34 0.46**

Note. a = for 9-week follow up models: random intercept and fixed effects were modelled; 9-week follow-up = change between Time 0 and Time 3; Intercept = baseline respective dependent variable assessment in control condition; Time = change over time in reference group; PA = physical activity; Est = estimate; CI_{95} = Lower and Upper levels of 95% Confidence Interval. For sample sizes at each measurement point see Fig. S1. Bold coefficients represent significant relationships. Coefficients in italics represent statistical trends ($p < .10$). Values < 0.01 in the table represent values such as 0.002, but larger than 0. Values > −0.01 in the table represent values such as −0.002 but smaller than 0. For self-reported habit strength up to the 9-week follow-up: true $R^2 = 0.07$; for the use of individual planning up to the 9-week follow-up: true $R^2 = 0.06$ and the use of collaborative planning up to the 9-week follow-up: true $R^2 = 0.05$; for collaborative social control up to the 9-week follow-up: true $R^2 = 0.03$.

planning condition (see Supplemental Materials). Sensitivity analyses (1) controlling for potential confounders and (2) using listwise deletion for missing data yielded patterns of results that were similar to those obtained in the main analyses (Tables S2 and S4, Supplemental Materials).

3.4. Effects of three types of planning interventions on the use of collaborative planning

The results of the mixed model analysis (Table 2) showed a significant interaction of the Time x Dyadic planning condition ($p = .009$) and a significant interaction of the Time x Collaborative planning condition ($p < .001$) in models explaining the use of collaborative planning at T3. These effects were obtained when the planning conditions were contrasted with the active control condition. Regarding T0 to T3 changes in the use of collaborative planning, persons in the control condition showed a decrease of −0.14 points, whereas participants in the dyadic and collaborative planning conditions showed increases of 0.23 and 0.52 points, respectively (Tables 1 and 2). The dyadic planning condition had a medium-sized difference when compared to the control condition ($d_{ppc2} = 0.46$), while the collaborative planning condition had a medium-to-large sized difference compared to the control condition ($d_{ppc2} = 0.78$; Table 1). In contrast to the effects observed in the dyadic and collaborative planning conditions, no significant interactions were found for the individual planning condition (Table 2).

Additional analyses, conducted with either the individual planning condition or the dyadic condition as the reference groups indicated significant additional Time × Condition interactions. Specifically, the T0-T3 increases in the use of collaborative planning were larger in the collaborative planning condition, compared to the changes observed in both the individual planning and the dyadic planning conditions (see Supplemental Materials). Sensitivity analyses, controlling for potential confounders and using listwise deletion for missing data (Tables S2 and S4, Supplemental Materials), confirmed the pattern of effects that was similar to those obtained in the main model.

3.5. Effects of three types of planning interventions on collaborative social control

The results of the mixed model analysis (Table 2) showed a significant Time x Dyadic planning condition interaction ($p = .013$) and a significant interaction of Time x Collaborative planning condition ($p = .009$) for collaborative social control at T3. These effects were obtained when planning conditions were contrasted with the active control condition. Participants in the control condition showed a decrease of 0.04 points of collaborative social control (on average; response scale ranging from 1 to 4) between T0 and T3, whereas participants in the dyadic and collaborative planning conditions showed increases of 0.30 and 0.32, respectively (Tables 1 and 2). The values of the d_{ppc2} coefficient suggested medium sized effects, with d_{ppc2} values of 0.39 for both the dyadic and collaborative planning conditions, compared to the control condition (Table 1). In contrast to the effects on collaborative social control observed in the dyadic and collaborative planning conditions, no significant interaction was found for the individual planning condition (Table 2).

Additional analyses, conducted with either the individual planning condition or the dyadic planning condition as the reference groups indicated no other significant Time × Condition interactions (see Supplemental Materials). In addition, the two sensitivity analyses (i.e., controlling for the potential confounders, using listwise deletion for missing data) showed a pattern of results similar to the main model (Tables S2 and S4, Supplemental Materials).

4. Discussion

This study showed that the three types of planning interventions resulted in distinct patterns of changes in the automatic, conscious, and social process variables. Taking part in the individual "I-for-me" planning intervention was related to a stronger habit at the 9-week follow-up. This was different for the dyadic "we-for-me" planning intervention, which in turn resulted in a higher level of the use of collaborative planning and a higher level of collaborative social control. A different pattern emerged among participants of the collaborative "we-for-us" planning intervention, where stronger habits, higher levels of the use of individual and collaborative planning, and higher levels of collaborative social control were found, compared to the control condition. Across the findings, the effect sizes were of medium size, with values of the d_{ppc2} coefficient ranging from 0.38 to 0.78. These medium effect sizes may be considered as representing minimally clinically important differences (Norman et al., 2003).

The findings obtained for the individual planning intervention confirm our assumption and the key hypothesis behind implementation intentions, with stronger habits induced by planning (Bieleke et al., 2021; Gollwitzer, 1999; Prestwich et al., 2015). The "I-for-me" intervention represented the simplest type of planning where social process variables were not considered. We did not find effects for the individual planning intervention on the self-reported use of planning, which contrasts previous research (Keller et al., 2021; Luszczynska et al., 2016). The absence of the use of individual planning may be explained by the specificity of the applied procedures. In our study, the procedures relied on weekly sessions devoted to forming plans for the upcoming week. These sessions were conducted across 5 consecutive weeks. Thus, the participants were not prompted to engage in the use of individual planning on their own, and they could expect that weekly meetings with the experimenter would provide an opportunity for a plan formation. Such intervention procedures might result in "skipping" the stage where the effortful use of individual planning occurs. As a consequence of regularly repeated planning sessions, stronger PA habit, operationalized as automaticity in responses to situational cues, may occur (Hagger, 2019). Whether enhanced PA habit translates to a change of behavior is yet another issue: as shown in previous analyses of the data obtained in the same trial, the individual planning intervention did not result in an increase of accelerometer-measured MVPA at 8 months after baseline (Kulis et al., 2022). This, however, might be explained by the long time span between the 9-week follow-up used in this study and the 8-month follow-up, applied for MVPA outcomes.

The findings for the dyadic "we-for-me" planning condition yielded support for the models capturing dyadic exchanges in the context of coping with an illness, such as the systemic transactional model (Bodenmann, 1997), the congruence model (Revenson, 1994), or the relationship-focused model (O'Brien and DeLongis, 1996). These models unanimously highlight the key role of social process variables as determinants of health-related behaviors. Participants of the dyadic planning intervention reported an increased use of collaborative planning, which reflects a combination of conscious and social processes. Both the dyadic planning intervention and the use of collaborative planning account for forming plans *together* with the partner. This effect was combined with an increase in another social process variable, highlighting "togetherness": the dyadic "we-for-me" planning intervention influenced participants' reports of the use of collaborative social control strategies by their partners. Importantly, the social process variables, initiated by the dyadic "we-for-me" intervention, resulted in an increase of MVPA measured objectively at 8 months after baseline (Kulis et al., 2022).

The fact that only social processes were affected by the dyadic planning intervention might result from the specificity of the dyadic planning format, in particular the roles assigned to the participants during the intervention. The dyadic planning concept was coined in the context of a study with people with a chronic illness (Burkert et al., 2011), where health and health-related behaviors of the focus person were consistently supported and/or controlled by the dyadic partner. These roles are played by the dyad during the intervention, which may reinforce the further use of collaborative planning or collaborative social control. Placing the participant in the role of the person being the focus of social efforts of the partner, may render the use of individual planning (a conscious process) unnecessary, and/or the use of individual planning may be replaced by the use of collaborative planning. We expected that engaging the partner into the dyadic planning process made the plan formation a more complex and demanding task, and therefore it may activate conscious processes, instead of automatic processes (Hagger, 2019). Supporting this hypothesis, a change in habit strength was not observed in the dyadic planning condition. We also found that the use of collaborative planning was co-occurring with collaborative social control: the T3 associations between collaborative social control and the use of collaborative planning were the strongest of all bivariate associations obtained in this study, with $r = 0.68$. It may be expected that these two social processes may also reinforce each other.

The collaborative “we-for-us” planning condition influenced the same social process variables as the dyadic planning condition did, also resulted in stronger habits and higher levels of the use of individual planning. Such results may be interpreted as confirming integrative dual-process models (Hagger and Hamilton, 2020; Strack and Deutsch, 2004), highlighting that behavior change may be explained by an interplay of automatic and conscious processes. The results also suggest that a further theoretical integration of the dual processes variables with social process variables is needed, perhaps in particular in the case of regularly performed behaviors such as PA (Rhodes et al., 2020).

The collaborative planning intervention resulted in an increase of all four outcome variables tested in this study. This reflects a major regulatory and social effort, that may be a consequence of a high complexity of the tasks practiced during the intervention. Participants of the collaborative planning intervention were not only asked to plan their own behaviors but to negotiate the plan with the partner, adjust plans so that they fit daily demands and environmental challenges of the participant and those of their partner, followed by the complex task of synchronous PA performance. PA synchrony among romantic couples is small-to-moderate (Pauly et al., 2020), therefore it may be expected that achieving high synchrony of regular PA among dyads, including not only romantic couples but also friends or coworkers , may be a task that is more difficult than “just” engaging in regular PA. In sum, the collaborative planning intervention may prompt individuals to pursue goals which are more complex than those established in “I-for-me” or “we-for-me” planning interventions. The complexity of the task may prompt individuals to use automatic, conscious, and social processes to achieve their behavioral goals. Still, the collaborative planning intervention did not influence MVPA, as measured by accelerometry 8 months after baseline (Kulis et al., 2022). Thus, a complexity of the task may affect the likelihood of the failure in behavioral enactment.

Besides its strengths, such as the comparison of three types of interventions, the study has several limitations. Testing putative mediators linking the experimental group assignment with the behavioral outcome (MVPA) may involve the use of sequential or parallel mediation models; this approach, however, would require a sample of at least twice the current size to secure adequate power for detecting small-to-medium effects. Further, the effects of the intervention were assessed at one follow-up only. Multiple follow-ups would have provided a better insight into the order in which the automatic, conscious, and social processes may occur. We also did not assess other types of planning such as self-reported dyadic planning (Burkert et al., 2011) or other social process variables such as positive and negative social control (Lewis and Rook, 1999), and social support (Keller et al., 2020; Rhodes et al., 2020), or other conscious process variables such as self-efficacy (Prestwich et al., 2014). Including these variables could have provided a more comprehensive picture of the processes evoked by different types of planning interventions and should be addressed in future research.

In summary, this study provided preliminary evidence for the distinct patterns of effects of individual, dyadic, and collaborative planning interventions, compared to an active control condition. This evidence was obtained in the context of increasing regular MVPA. The individual “I-for-me” planning intervention resulted in stronger habits (an automatic process). The dyadic “we-for-me” planning intervention prompted social process variables, including collaborative social control and the use of collaborative planning. The collaborative “we-for-us” planning intervention resulted in an increase in habit strength, and the use of individual planning, but also in an increase in the use of collaborative planning and collaborative social control. These changes in automatic, conscious, and social process variables, evoked by the “we-for-us” planning intervention, may reflect the major regulatory effort of forming joint plans and subsequently integrating regular joint PA into the weekly schedule.

Credit author statement

Ewa Kulis: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Visualization, Writing - original draft, Writing - review & editing. **Zofia Szczuka:** Data curation, Investigation, Project administration, Resources, Visualization, Writing - review & editing. **Anna Banik:** Data curation, Investigation, Project administration, Resources, Writing - review & editing. **Maria Siwa**: Data curation, Investigation, Project administration, Resources, Writing - review & editing. **Monika Boberska:** Data curation, Investigation, Project administration, Resources, Writing - review & editing. **Nina Knoll:** Conceptualization, Formal analysis, Methodology, Writing - review & editing. **Theda Radtke:** Conceptualization, Writing - review & editing. **Urte Scholz:** Conceptualization, Writing - review & editing. **Ryan E. Rhodes**: Conceptualization, Writing - review & editing. **Aleksandra Luszczynska:** Conceptualization, Funding acquisition, Methodology, Software, Supervision, Validation, Writing - original draft, Writing - review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data is available at https://osf.io/68gp2/, as indicated in the manuscript.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2022.115477.

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Artykuł 3: Physical Activity Planning Interventions, Body Fat and Energy-Dense Food Intake in Dyads: Ripple, Spillover, or Compensatory Effects?

Kulis, E., Szczuka, Z., Banik, A., Siwa, M., Boberska, M., Zarychta, K., Zaleśkiewicz, H., Knoll, N., Radtke, T., Scholz, U., Schenkel, K., & Luszczynska, A. (revise and resubmit). Physical activity planning interventions, body fat and energy-dense food intake in dyads: Ripple, spillover, or compensatory effects? (revise and resubmit to the do *Psychology & Health)*

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233592329 (Psychology & Health) A revise decision has been made on your submission

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17-Mar-2023

Dear author,

(Please note that your name has been withheld to protect your anonymity, as the reviewers receive a copy of this letter.)

Your manuscript entitled "Physical Activity Planning Interventions, Body Fat and Energy-Dense Food Intake in Dyads: Ripple, Spillover, or Compensatory Effects?" which you submitted to Psychology & Health, has been reviewed. The reviewer comments are included at the bottom of this letter.

You will see that although the referees find some merit in the paper they suggest that substantial revisions would need to be completed before we can consider it further. I have reviewed the manuscript as well, and agree with the reviewers' assessment.

In particular, the reviewers asked for some clarity and adjustments regarding several points in the introduction, additional detail about the parent study in the methods, conceptual clarity regarding the ripple effect construct, additional dyadic analyses, and more attention to the study's limitations in the discussion.

We hope that you will be able to undertake the additional work on the paper and look forward to receiving a revised manuscript in due course.

When you revise your manuscript please highlight the changes you make in the manuscript by using a red font.

To submit a revision, go to https://rp.tandfonline.com/submission/flow?submissionId=233592329&step=1. If you decide to revise the work, please submit a list of changes or a rebuttal against each point which is being raised when you submit the revised manuscript.

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Once again, thank you for submitting your manuscript to Psychology & Health and I look forward to receiving your revision.

Sincerely,
Dr Rebecca Ferrer
Associate Editor, Psychology & Health
ferrerra@mail.nih.gov

Reviewer(s)' Comments to Author:

Reviewer: 1

Comments to the Author
This manuscript describes secondary analyses of a randomized controlled trial with 320 dyads examining different types of effects for three physical activity (PA) planning interventions (vs. an active control group) on dyad members' body fat and energy-dense food intake. Planning interventions comprised a) individual planning, b) dyadic planning, and c) collaborative planning. Dyad members were romantic partners, friends, or family members, with one person being the target person (i.e., "person-in-need"; not adhering to WHO PA recommendations) and the other person being described as the partner; a potentially support providing person, particularly in the dyadic and collaborative planning interventions. Among other findings, the authors found a ripple effect, that is, an improvement in partners' body fat for the PA planning interventions (vs. control group), whereas non-sign. time x group interactions were observed for target persons. An overall pattern of reduction in energy-dense food intake over time was found across target persons and partners and groups. Strengths of this manuscript include the examination of a large dyadic sample, a comprehensive research design (medium-term follow-ups, 4 group conditions), and relevant observations for practitioners and future research.

However, I have the following major concerns:
Abstract
1. An argument for a research gap and/or a rationale for study objectives is missing in the "Objectives" part (as a first sentence).
2. The last sentence of the Abstract is unclear to me and I only know what is meant by it when reading the full Discussion. Also, I would not overinterpret the statistical trend, given the sufficiently powered study and seeing Figure S4 (see also my point 10).
Introduction:
3. You mention that the ripple effect was found in an earlier study (J. Keller et al., 2020). It is important to emphasize that it was not found for the behavioral outcome (MVPA), but for a physiological outcome (physical fitness). Your study confirms this pattern for another physiological outcome (body fat).
4. Page 6, sentence "However, further research is needed to explain …": Why is it needed? What would it tell us for practitioners and future interventions? Please add this detail to strengthen the rationale for the study objectives.
5. Research questions (Pages 6-7): I understand the explorative nature of the research questions and – in general – I find it relevant to examine ripple effects as well as further effects of interventions. However, information from primary findings from this trial should be introduced before listing the research questions. Currently, the reader needs to read the Discussion to see the trial findings on the MVPA outcome. I think, a reader needs to know whether participants actually improved their MVPA as a consequence of the PA planning (or whether they did not) in order to understand research questions about potential "spillover" or "compensatory" effects.
6. Moreover, as all participants received a nutrition education, I find it hard to write about spillover and compensatory effects (for outcomes related to nutrition; body fat is even related to both PA and nutrition). If there would be a change between intervention groups and control group: Would this be due to receiving another dose of PA treatment or due to the proportion of nutrition vs. PA treatment doses? I am not sure. As the trial was not primarily designed to investigate spillover

and compensatory effects, one could choose a more general approach and write about “further side effects”.

Methods:

7. I would start with “Design and Procedures” [before “Participants”] to highlight that the study reports secondary analyses and list that the study was conducted in Poland (as Poland is referred to in the Participants section, without introducing data collection details before)
8. To improve interpretation of the time trend in Tables 2 and 3 (coefficients around 0.00), I recommend to code the time with 0, 0.25, and 1 for T0, T3, and T4. Here, 0.25 means 9/36. The authors will then see in the coefficients, which change is predicted between T0 and T4 in the control group; analogous to Table 1 statistics.

Results:

9. Page 14, “We found Time effects for target persons (p < .001) and partners (p = .041).”: The main effect of the time trend refers to the change in the reference group, when a time x group interaction is modelled. Thus, please add “from the control group” within that sentence. The same statistics are reported in lines 45-47, which might be redundant as it again refers to the control group.
10. In the Result section and throughout the manuscript, I would not highlight statistical trends that much as the study was sufficiently powered. When an effect is not significant at p<.05, I would interpret it as non-significant. This also applies to the Discussion, where much emphasis was given to such statistical trend observations.

Discussion:

11. Page 15, “a mean difference of 1.58%”: This number is not reported beforehand. Please add in Results or remove in the Discussion.
12. As mentioned in point 10, I would not emphasize statistical trends that much.
13. The “intervention dose” of all 4 conditions should be discussed comprehensively. The control group received PA and nutrition education, the other groups as well. Additionally, the 3 planning conditions received a PA-focused extra treatment; and 2 conditions with a higher degree of partner involvement. I would also interpret overall improvements in energy-dense food intake in light of the nutrition education, which received all participants. This is nicely shown by Figure S4.
14. Page 17, “A lack of a reduction in body fat among target persons may be explained by a trend for a smaller reduction in the energy-dense food intake”: When the authors discuss it this way, why not analyzing it with their data? Please provide such analysis, e.g. using the Supplemental Material.
15. General comment regarding interpretations of findings: Is there really a compensatory effect regarding energy-dense food intake? I see that all groups improved (or decreased) their energy-dense food intake. Only in the individual planning group, the decrease was not as steep as in the control condition. Maybe this points to a compensatory effect (even though I would expect that the level of energy-dense food intake increases when speaking about a compensatory effect). In the collaborative planning condition, however, the slope was steepest (see Figure S4) and the time x group interaction is positive (but non-sign.). Thus, PA planning is not worsening it per se. I would not conclude that we see an overall compensatory effect. My main conclusion from the present findings is that “side effects” of PA planning can differ between different forms of planning across target persons; with individual planning showing the weakest side effects on the reduction of energy-dense food intake.
16. Please add a short paragraph or some sentences on implications of present findings for practitioners and future research.
17. Limitations: I recommend to add that mechanisms of potential compensatory or spillover effects remain unknown and need to be examined by future research using study design XY. Mechanisms of ripple effects could be examined using dyadic studies and APIM analyses.

I have the following minor concerns:

18. Abstract: The type of dyads should be listed.
19. Introduction, page 3: Please correct the sentence “…aiming at an improvement of self-regulatory skills and one health behavior …”.
20. Introduction, page 4, spillover/compensatory […] and overweight/obesity […]: Please write as spillover or compensatory […] as well as overweight or obesity […].
21. Introduction, page 5, meta-analysis from Wewege et al: -1.46% refers to an average effect from a meta-analysis, right? Please rephrase the sentence to clarify that this refers to evidence across multiple studies.

22. Introduction, page 6, sentence “Research involving dyads of a target person (attempting to improve their PA levels) and their partners …”: Please consistently use singular or plural.
23. Introduction: The authors cite L. Keller et al. (2020), J. Keller at al. (2020), and Keller et al. (2020) – please correct the latter.
24. Introduction, page 7, “controlling for changes in respective outcomes at 9 weeks after baseline”: This is not "controlling" when the 9 weeks assessment is part of the time trend modelling. I would delete this part of the sentence.
25. Page 9, line 22: “a session where repeated healthy diet” reads incorrect, please rephrase.
26. Page 9, line 43: “you” should be “I”.
27. Page 15, Wewege et al. (2021): Please again clarify that this refers to meta-analysis evidence.
28. Table 3: The coefficient of the Time x Individual planning interaction should be negative, given the authors’ interpretation and seeing Figure S4 (i.e., less steeper slope than the control condition).

Reviewer: 2

Comments to the Author
This study examined whether physical activity planning interventions reduced body fat percentage and intake of energy-dense foods among dyads compared to active control conditions. Results showed that, although there were no interaction effects between time and study condition for target persons' body fat, partners showed reductions in body fat compared to partners in the control condition. Additionally, target persons and partners showed a reduction in energy-dense food intake across time (across conditions).

This manuscript was well-written, clear, theoretically-grounded, and methodologically-sound. I was particularly impressed by the sample size and the length of time for assessment/follow-up, as well as the overall contribution to the body of work examining spillover and compensatory effects of PA interventions.

I have one point of concern. The authors noted that the partners in the control condition showed an increase in their body fat of 0.74%, whereas body fat in partners in planning conditions decreased by -0.84%. Is this difference meaningful, especially over the course of 36 weeks? As the authors note in the discussion, this is a mean difference of 1.58%. I looked at the materials on OSF but it looks like the authors did not pre-register hypotheses and the authors do not state the size of their anticipated effects in their manuscript.

I do not feel that the authors overstate the magnitude of their findings/effects in the discussion (and, in fact, point to similarly sized changes in body fat found by Wewege et al., 2021). However, it would be helpful if the authors were to add a few sentences in the discussion section or limitations section qualifying these results / commenting on whether the magnitude of the difference between body fat reductions in partners in planning conditions vs. control is practically/meaningfully significant, as this has implications for future work/interventions.

Reviewer: 3

Comments to the Author
This secondary analysis aimed to evaluate whether PA planning interventions within the context of a behavioral weight loss (BWL) randomized controlled trial reduced body fat in partners (ripple effect) and if the individual enrolled in the BWL program experienced a decrease (spillover effect) or increase (compensatory effect) in their energy dense foot intake. Three types of PA planning interventions (individual, dyadic, collaborative) were compared to an active control. Outcome variable of the primary intervention study was MVPA at 36 weeks post-baseline. Results suggest that partners of individuals who engaged in the BWL intervention reduced their body fat compared to an increase seen in partners in the active control condition (ripple effect). PA planning interventions did not significantly reduce energy dense food intake compared to the control condition for individuals involved in the BWL intervention.

Major Comments
1. Introduction & Framing
To strengthen this manuscript, the authors may consider adjusting the introduction section and overall framing. Specifically, consolidating background information to clarify and streamline the support for the primary aims and purpose of the study. Once the reader gets to the aims and purpose, these ideas are clear and concise; however, the information leading the reader there feels disconnected and does not fully justify or support the aims and purpose of the study.

2. Parent Study and Supplemental Information
Much of the manuscript references the supplemental information. While this helps with brevity, a few important factors and details appear to be missing. This paper would be clearer to readers if there were more information about the parent study (e.g., the weight loss intervention) and inclusion criteria (specifically information about both the target and partner information). Without this information, the introduction section is misleading given that this appears to be a secondary data analysis for an intervention designed to test dyadic components of a weight loss intervention not solely a PA planning intervention. Without fully explaining this in the methods or introduction section, it is difficult to understand if there is truly a spillover effect of PA planning when nutritional education is included across all conditions and the control group in the standard weight loss intervention materials. Furthermore, it appears that the parent study was designed to look at three different types of planning interventions; however, this study mentions the three different types in the introduction yet collapses them into one “PA planning” statement throughout the discussion section.

3. Ripple Effect
Given the aim of assessing for a ripple effect, please provide a rationale for the decision not analyze data at the dyadic level (e.g., dyadic statistical analysis). This seems to be a missed opportunity given that data from both members of the dyad are available.

Minor Comments
PA Planning Interventions
1. Please explain the rationale for why self-regulatory skills and dyadic PA planning in particular is important? Why is it superior to collaborative PA planning? Or is it not? Hard to understand with the introduction and lack of evidence to support this.
2. Dyadic vs. collaborative: how did this study ensure that dyadic planning didn’t become collaborative type plans? What intervention manipulation checks were used?
Discussion
1. p. 17 idea: cognitive demand to support change in one area taxes ability to focus on more than one goal. Please provide extra rationale for this. what about if someone believes they “earned it”?
2. p. 17 lines 37-42: was there deliberate attempt to change energy dense intake? Please explain this better in the methods section.

Reviewer: 4

Comments to the Author
This manuscript reports the results of a randomized controlled trial of three physical activity planning interventions that enrolled a large number (N = 320) of dyads and examined changes in body fat in body fat and energy-dense food intake over a 36-week period. Each dyad included a target person whose physical activity fell below recommended guidelines and a partner whose role in the intervention varied as a function of the particular condition to which dyads were randomly assigned. In an individual planning condition, the dyad members each developed individual plans for increasing their physical activity. In a dyadic planning condition, the dyad members worked together to develop dyadic plans for increasing the target person’s physical activity, and the partner actively supported the target person’s plan formation. In a collaborative planning condition, the dyad members developed joint plans to increase their physical activity together. The study also included a fourth active control condition that emphasized provision of educational materials to dyad members. The study design impressed me as quite strong, with meaningful potential to shed light on specific dyadic contexts that facilitate health behavior change. In addition, the authors

sought to investigate the interesting possibility of a ripple effect, in which beneficial health changes achieved by target persons would be evident, as well, in their partners. The authors' study design allowed them to evaluate, further, whether any ripple effects documented were more likely to occur in particular intervention conditions. Because health behavior change efforts often occur in a dyadic context, learning whether a target person's health behavior change transfers, in a sense, to his/her partner is an important question for the field. If documented, such ripple effects might suggest ways to extend the potential benefits of health behavior interventions to romantic partners, family members, or others who were not the primary focus of the intervention but who might share similar health risks. (Please see comment 3 below, however, regarding the notion of transfer of an intervention effect from target persons to their partners.)

The authors also investigated whether a similar kind of transfer might occur from the primary health outcome targeted by the intervention (body fat, in this study) to another, non-targeted health outcome (energy-dense food intake). They examined two alternative forms of such transfer: a spillover effect, in which improved self-regulatory capacities might lead to reductions not only in body fat but also in energy-dense food intake, and a compensatory effect, in which the effort to change a health outcome depletes self-regulatory resources and thus jeopardizes effective goal pursuit of another health outcome. This issue, too, is important for the field and has been investigated relatively infrequently, with somewhat mixed results, as summarized nicely in the authors' excellent, theoretically-grounded introduction.

As suggested by this lengthy summary, I found the questions posed by the authors to be fascinating and the study itself to have impressive strengths. The recruitment of 320 dyads is quite an achievement in its own right. The measures are strong and the data analyses are sophisticated. The authors' interpretation of their findings displays the rich theoretical framing that is evident in their introduction, and they are forthright in discussing the study's limitations. I recognize that the absence of some findings that the authors might have been expected to emerge from the study (e.g., greater evidence of distinctive effects of the three intervention conditions and, perhaps, greater evidence of effects for target persons) is a bit disappointing. On balance, though, I thinks the strengths of the study and its potential to stimulate future research outweigh its limitations. I might add that the manuscript is very well written. Given these many strengths, I have only a few questions and suggestions.

1) I believe that the authors' labels for the intervention conditions have the potential to cause some confusion among readers. This is particularly true for the dyadic intervention because all of the interventions involved dyads. It seems to me that a better label might be "support condition" or "partner-support condition." The individual condition could also be somewhat confusing, as it involved both dyad members, albeit in largely parallel planning activities. A better label that is not cumbersome did not come readily to mind, but the authors might want to consider possibilities. The most important change, I believe would be change the label of the dyadic condition.

2) In a related vein, the terms ripple effect and spillover effect have sufficiently similar meanings or connotations that some effort is required to keep them straight as one reads the manuscript. I wondered whether expanding the labels a bit would aid reader comprehension. For example, ripple effect could be relabeled "interpersonal ripple effect" or "target-partner ripple effect." Spillover effect could be relabeled "health-behavior spillover effect." These are just suggestions, of course, but some relabeling that signals the interpersonal vs. health-behavior contexts in which these effects are expected to occur would be helpful.

3) The study revealed that partners, but not target persons, who participated in the interventions (particularly the dyadic intervention) reduced their body fat. The authors construed this as evidence of a ripple effect and explained it in terms of partners who might have wished to be supportive by modeling behavior change (increasing their own physical activity) for the target persons, leading the partners to experience a decrease in body fat. Objective assessments of physical activity would be needed, of course, to substantiate this interpretation, but I wish to emphasize, instead, that the findings challenge the notion that a ripple effect entails a transfer of health behavior change from target persons to their partners. This view of ripple effects (attributed to Gorin et al., 2008) is presented on p. 6, "…some types of [physical activity] planning interventions delivered to dyads may result in a ripple effect, that is a process in which effects are transferred from one dyadic

member to another (Gorin et al., 2008).” This particular meaning of a ripple effect is not supported by the authors’ findings, as the target persons did not exhibit a reduction in body fat and probably did not increase their physical activity; thus, there was no health effect per se that could have been transferred from the target persons to their partners. At other points in the manuscript, the authors characterize ripple effects as arising simply from partners’ participation in an intervention focused on the target persons or from partners’ desire to support the target person during the intervention. These alternative meanings of a ripple effect need to be clarified and reconciled in the manuscript, as they differ in subtle, but important, ways.

4) In seeking to explain why target persons did not lose body fat in the interventions and exhibited a small (relative to participants in the control condition) reduction in energy-dense food intake, the authors offered both self-regulatory and habit-strength explanations (p. 17). They reasoned that target persons’ efforts to increase their physical activity may have drained self-regulatory resources to some extent, thereby reducing their ability to achieve another heath goal (reduction of energy-dense food intake). This is an intriguing possibility and one for which additional evidence in future studies will be desirable. The authors also noted that target persons did not meet recommended guidelines for physical activity at baseline and, additionally, had obesity or chronic disease, very likely reflecting strong habits around energy-dense food intake that are difficult to change. This too, is an intriguing idea that warrants further investigation. I would like to suggest an additional explanation for the authors to consider. People who have obesity or chronic disease often experience pain or discomfort when they seek to increase their physical activity. Rakowski (1997) observed in an insightful book chapter that heath itself is a resource for health behavior change. This authors might consider adding the interpretation and might also examine whether arthritis or other chronic conditions that make physical activity painful were more common among the target persons, compared to their partners.

5) The generally lean evidence of distinctive effects of the different physical activity planning intervention conditions warrants a comment in the discussion section. Readers might have anticipated that the collaborative planning condition would have yielded the most beneficial results. What should they conclude about the limited evidence of distinctive effects of the interventions?

6) The authors might add to the discussion of study limitations on p. 18 that including accelerometer data behind the baseline in a physical activity intervention would aid the interpretation of study findings and would be an important variable to track in its own right.

7) I may have missed it, but I could not find in the manuscript or supplemental materials what made the control condition an active control condition. Brief clarification would be helpful.

8) This is also minor quibble, but energy-dense food intake might not have been an entirely non-targeted outcome as is implied in the manuscript because the interventions and control condition included nutrition education. The authors probably should comment briefly on whether or not the inclusion of nutrition education in all study conditions might have a bearing on their framing of spillover vs. compensatory effects.

Physical Activity Planning Interventions, Body Fat and Energy-Dense Food Intake in Dyads: Ripple, Spillover, or Compensatory Effects?

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Abstract

Objectives: This study tested if physical activity (PA) planning interventions may influence a body fat reduction in target persons but also among their dyadic partners (a ripple effect). Second, we investigated if PA planning interventions may result in a decrease in energy-dense food intake (a spillover effect) or an increase in energy-dense food intake (a compensatory effect).

Method: *N* = 320 dyads were assigned to an individual, dyadic, or collaborative planning intervention or an active control condition. Body fat and energy-dense food intake were measured at baseline and at the 36-week follow-up.

Results: No Time x Condition effects were found for target persons' body fat, but there was a reduction in body fat among partners participating in any PA planning intervention, compared to the control condition. Across the conditions, target persons and partners reduced energy-dense food intake over time. The reduction tended to be smaller among target persons assigned to any PA planning condition compared to the control condition.

Conclusions: PA planning interventions delivered to dyads may result in a ripple effect involving a body fat reduction among partners. A reduction may be absent among target persons, as the PA planning intervention may activate compensatory changes in energy-dense food intake.

Keywords: planning; dyads; physical activity; body composition; healthy diet

Besides such indicators of obesity as body mass index (BMI), body composition is of great clinical and public health relevance because excess fat mass and an inadequate fat to fat-free mass ratio represent an important risks of chronic diseases, after controlling for BMI (Neeland et al., 2018). Excessive body fat, particularly in the presence of an excess of visceral adipose tissue, is also often associated with the storage of fat in organs, such as skeletal muscles, pancreas, liver, and heart. Intake of food of high energy density, such as fat-rich products, is also an important risk factor for obesity and high body fat levels (Vernarelli et al., 2015). Food rich in carbohydrates contributes to insulin resistance and unfavorable changes in the distribution of fat tissue, such as moving fat from peripheral to central deposits (Paniagua, 2016). Physical activity (PA) is yet another determinant of the proportion of body composition, including the percentage of body fat (Westerterp, 2018). Prospective research suggested that the level of body fat (in relation to non-fat mass) increased the risk of mortality and it showed prognostic values in explaining mortality that exceeded that of simple BMI (Sedlmeier et al., 2021). A reduction of high energy-dense food intake, an increase of PA, and a reduction of body fat constitute key targets of any obesity prevention programs.

Psychosocial interventions, aiming at an improvement of self-regulatory skills and one health behavior, may either increase (*spillover effect*) or reduce (*compensatory effect*) the likelihood of a successful initiation or maintenance of another health behavior (Geller et al., 2017). Spillover effects are rooted in the assumption that an individual learns self-regulatory skills while attempting to change such behaviors as PA, and those skills may be later used successfully while attempting to adopt a healthy diet (Hagger et al., 2010; Halliday et al., 2014; Mata et al., 2009). Compensatory effects may be explained by the strength-energy model and its assumption that exerting self-regulatory effort in the adoption of one health behavior may deplete self-regulatory resources of the individual which may result in difficulties in self-regulating another behavior (Hagger et al., 2010). Thus, adopting several self-regulatory-demanding behaviors simultaneously (e.g., regular PA, a reduction of sedentary time, and an adoption of a healthy diet) is likely to result in excessive demand for self-control resources and failure to achieve one or all behavior change goals (Hagger et al., 2010). Another explanation for compensatory effects is related to beliefs that it is acceptable to engage in a health-compromising behavior because it may be compensated by another, already initiated health-promoting behavior (Radtke et al., 2012).

The empirical evidence for spillover and compensatory effects of PA-related intervention on dietary patterns is accumulated mostly in cross-sectional studies (for review see Geller et al., 2017). The evidence for spillover/compensatory effects obtained in prospective or experimental research is mixed. An observational study without a control group showed that among adults with overweight/obesity, taking part in resistance training resulted in a lower energy-dense food intake at the measurement taken directly after completing a 12-week training (Halliday et al., 2014). However, the reduction of energy-dense food intake was not sustained at follow-ups (Halliday et al., 2017). Higher PA levels of resistance training for participants tended to be related to a decrease in body fat (Halliday et al., 2017). Another study suggested that a PA training delivered to sedentary women resulted in a decrease in fat intake across one control and two experimental conditions, but no Time x Group interactions were observed (Dutton et al., 2008). Fleig et al. (2011) compared the effects of a psychological self-regulatory intervention, including, among others, PA action planning, with changes in fruit and vegetable intake in a control condition. Participants from the intervention group reported an increase in fruit and vegetable intake 6 weeks after the discharge from in-patient rehabilitation (Fleig et al., 2011). Concluding, the experimental evidence for the spillover/compensatory effects of PA interventions on energy-dense food intake is limited and mostly gathered in interventions involving organized PA training sessions rather than psychosocial interventions addressing self-regulatory skills.

PA training interventions result in small but significant reductions of body fat. Compared to the control condition, resistance training reduced body fat percentage by –1.46% (for meta-analysis see Wewege et al., 2022). Short-term moderate-intensity to high-intensity exercise training can induce modest body composition improvements in people with overweight or obesity, without accompanying BMI changes (Wewege et al., 2017). Although a number of studies tested the effects of organized PA training on body fat, to our best knowledge, there is no evidence for the changes in body fat among adults enrolled in psychosocial interventions addressing PA self-regulatory competencies.

Planning may be listed among the most promising self-regulatory factors that may affect changes in PA. Reviews showed small-to-medium or medium effects of individual planning, usually observed after short-term follow-ups (< 3 months) (Carraro & Gaudreau, 2013). Research on the effects of planning is based on theoretical frameworks explaining the role of planning in the adoption and maintenance of regular PA (see e.g., implementation intentions approach, L. Keller et al., 2020; the health action process approach, Schwarzer & Luszczynska, 2015). When forming an individual action plan, individuals prepare links between characteristics of future situations and desired behaviors ("when," "where," and "how" behaviors will be enacted), whereas individual coping planning refers to identifying potential barriers that may hinder behavioral performance and planning how to overcome them (Hagger & Luszczynska, 2014). Going beyond the individual "I-for-me" planning approach, recent physical activity research highlights the role of social processes in which PA and self-regulation take place (Rhodes et al., 2020). In the dyadic "we-for-me" planning, a target person plans their own future behavior, whereas the main role of the partner is to assist in plan formation (Burkert et al., 2011; J. Keller et al., 2020; Knoll et al., 2017). Collaborative "we-for-us" planning occurs when a target person and their partner form plans together, and the plans refer to joint PA behavior enactment (Prestwich et al., 2012). Previous research testing the effects of individual, dyadic, and collaborative planning interventions focus on their influence on PA and sedentary behaviors (Knoll et al., 2017; Kulis et al., 2022; Prestwich et al., 2012; Szczuka et al., 2021). Research involving dyads of a target person (attempting to improve their PA levels) and their partners (who intend to support target persons in this attempt) indicated that some types of PA planning interventions delivered to dyads may result in *a ripple effect*, that is a process in which effects are transferred from one dyadic member to another (Gorin et al., 2008). Kulis et al. (2022) indicated that a dyadic PA planning intervention resulted in an improvement of moderate-to-vigorous physical activity (MVPA) among partners. Some evidence for ripple effects following a PA planning intervention was found in earlier dyadic research, focusing on PA outcomes (Keller et al., 2020). However, further research is needed to explain if the PA planning interventions, such as individual, dyadic, or collaborative planning, may contribute to a reduction in body fat and result in spillover or ripple effects, namely a reduction in energy-dense food intake in either target persons (who are recommended to change their PA) and/or their partners (romantic partners, friends, or family members, who intend to support target persons in this change).

The purpose of this randomized controlled trial was to investigate the effects of three types of PA planning intervention (individual, dyadic, and collaborative) on changes in body fat in target persons, but also a ripple effect, that is a reduction of body fat among dyadic partners. Second, we investigated the effects of PA planning interventions on a reduction or an increase in energy-dense food intake among target persons and their partners (spillover and compensatory effects, respectively). We investigated if, compared to an active control condition (PA, sedentary behavior, and healthy diet education), target persons and partners assigned to a PA planning intervention would reduce (1) body fat percentage and (2) energy-dense food intake. The effects were evaluated at 36 weeks after baseline (and 6 months after the completion of the PA planning intervention), controlling for changes in respective outcomes at 9 weeks after baseline.

Method

Participants

At Time 0 (T0), *N* = 320 dyads comprising adult target persons and their partners were enrolled (see Supplemental Materials, Figure S1). Target persons' mean age was 43.86 years (*SD* = 17.02; range: 18-90), 64.4% were women. Partners' mean age was 42.32 years (*SD* = 16.55; range: 18-84), 64.1% were women. The average body mass indices (BMI) in target persons and partners were 28.00 (*SD* = 6.42) and 25.68 (*SD* = 4.60), respectively; 62.2% of the target persons and 50.9% of the partners were overweight or obese. Most target persons and partners were in a romantic relationship (79% and 79.3%, respectively). All participants were white (as 99% of the population of Poland). Participants' education, economic status, and other characteristics of enrolled dyads are provided in Supplemental Materials (Table S1).

The inclusion criteria for target persons were being insufficiently physically active, specifically not meeting the World Health Organization (2010, 2020) recommendations of at least 150 minutes of MVPA per week and/or being recommended by a specialist to increase the number of MVPA minutes per week. As self-reported at the T0 measurement, 87.8% of the target persons and 77.5% of the partners did not meet the PA guidelines (WHO, 2010, 2020). Overall, 39.4% vs. 27.2% of target persons and 16.7% vs. 24.5% of partners reported cardiovascular disease and/or type 2 diabetes vs. other chronic illnesses. The recruitment strategy is reported in Supplemental Materials.

Design and Procedures

This study reports secondary outcomes of a randomized controlled trial (RCT), registered at ClinicalTrials.gov (#NCT03011385). The trial compared the effects of three types of physical activity planning interventions (individual, dyadic, collaborative) with an active control condition, with the MVPA assessed 36 weeks after baseline as the main outcome (Kulis et al., 2022). The three types of PA planning interventions and active control (education) procedures were delivered during three in-person meetings and four booster sessions (phone calls; for details see Kulis et al., 2022). Further details of the procedures are presented in Supplemental Materials, Figure S1, and in the study protocol, see Open Science Framework (https://osf.io/va8h3/?view_only=5cba896510e541f08f2a8e138ebdf31c).

The present study extends these findings and investigates the effects of the three types of PA planning interventions on body fat and energy-dense food intake. Data were collected three times: at baseline (Time 0, T0); at a 9-week follow-up (Time 3, T3), that is after the intervention and control group procedures were completed; and at a 36-week follow-up (Time 4, T4), approximately 6 months after the PA intervention was completed.

Data were collected between February 2016 and February 2020. The study was conducted in 25 urban and seven rural locations in six regions of Poland by 38 trained experimenters. The training consisted of at least two preparatory sessions prior to the study and regular supervision. Each face-to-face meeting was set at locations agreed upon by the participants and the research team. After each face-to-face session, participants received small gifts with an average value of up to 10 EUR. The study was approved by the Ethics Committee at the SWPS University, Wroclaw, Poland. Informed consents were collected from both members of the dyad. All data were coded to secure anonymity.

Randomization and Blinding

Randomization was conducted by a researcher blinded to the dyad enrollment and intervention assignment. The randomization included a non-stratified random digit generator of the condition, followed by the assignment of the dyads to the experimental conditions: individual (n = 82), dyadic (n = 83), or collaborative (n = 79) PA planning conditions, or the active control group (n = 76) (for participant flow see Figure S1, Supplemental Materials).

Intervention and Control Group Procedures

Detailed description of the delivery and the content of the PA planning intervention and control procedures is presented in Supplemental Materials. Study procedures for dyads in four experimental conditions included: (1) the education session on a healthy diet, including low energy-dense food intake at T0, (2) the education session on PA and sedentary behaviors (SB) at T1, one week later, (3) the repetition of the PA and SB education at T2, one week after T1, (4) a session where repeated healthy diet, PA and SB education at T3, seven weeks after T2, and (5) four brief reminders of the education during booster calls (three with weekly intervals after T2 and one with one week interval after T3). The education procedures included respective guidelines, recommendations, and simple tips for behavioral enactment. The control group took part in education sessions only, whereas planning groups additionally took part in planning sessions.

In the individual PA planning condition (at T1, T2, and T3), members of the dyad individually wrote down specific action plans about “when,” “where,” and “how” they were going to be physically active within the following 7 days (Luszczynska et al., 2007), followed by coping plans, “if situation X appears then you will cope with it by doing Y” (Sniehotta et al., 2006). The respective individual planning procedures were repeated during the four booster calls. In the dyadic PA planning condition (at T1, T2, and T3), the dyad formed specific dyadic action plans about “when,” “where,” and “how” the target person would be physically active, followed by dyadic coping plans. In contrast to individual planning, during the dyadic planning sessions, partners actively supported the target persons’ plan formation (Knoll et al., 2017). During four booster calls, participants were encouraged to make specific dyadic action and dyadic coping plans. In the collaborative PA planning condition (at T1, T2, and T3), members of the dyad discussed their joint plans and wrote down specific collaborative action plans about “when,” “where,” and “how” to be physically active together

(Prestwich et al., 2012) and collaborative coping plans. During four booster calls, each dyad was asked to form collaborative action plans and coping plans.

Measures

Body Fat (T0, T3, and T4)

Body fat level was assessed by the floor scales (BF-18 or BF-530; Beurer, Germany, measurement error < 5%) using the bioimpedance (BIA) method (Kyle et al., 2004), which determines the electrical impedance of an electric current through body tissues. Fat tissue was estimated with the Schaefer equation for BIA (Cleary et al., 2008). The measurement was conducted with bare feet and determined of the adipose tissue (target persons' average level at T0: $M = 32.08\%$, $SD = 9.42$, the lowest reported level of body fat was 10.6% and the highest reported level was 59.8%; partners' average level at T0: $M = 27.98\%$, $SD = 9.62$, the lowest reported level of body fat was 6% and the highest reported level was 63.50%).

Energy-Dense Food Intake (T0, T3, and T4)

The Energy-Dense Food Index consisted of eight items that assess the frequency of the energy-dense food intake and consumption of sweetened beverages (the National Cancer Institute, 2021). The measure included seven items assessing sweetened beverages intake and sweet and salty energy-dense food intake, e.g., "During the past month, how often did you eat doughnuts, sweet rolls, yeast cakes, puff pastries, muffins? Do not include sugar free items." The responses ranged from 0 = *never* to 8 = *2 or more times per day*. The responses were converted to a common unit of time (times per day; see the National Cancer Institute, 2021). Mean item responses were used. The internal consistency of the scale was acceptable for target persons with: $\alpha = 0.69$ at T0, $\alpha = 0.71$ at T3, and $\alpha = 0.70$ at T4, and for partners with: $\alpha = 0.69$ at T0, $\alpha = 0.72$ at T3, and $\alpha = 0.70$ at T4.

Control Variables (T0)

Accelerometers (ActiGraph wGT3X-BT) were used to assess baseline (T0) MVPA minutes per day. Data were included if accelerometers were worn for 3 to 6 consecutive days with a minimum of 8 hours per day of wearing the accelerometer, with exclusion of the first wear day; e.g., Prescott et al., 2020). MVPA in minutes per day were counted using the Sasaki et al. (2011) algorithm. Daily minutes of MVPA for each valid wear day were summed up and divided by the number of valid wear days (average MVPA values at T0 for target persons: M = 73.38, SD = 30.39 and partners: M = 81.89, SD = 31.00).

Sociodemographic variables assessed at T0 included participants' age, gender, education (ranging from 1 = *primary school only* to 4 = *a university degree*), perceived economic status ("Compared with the average economic status of families in the country, how would you rate the economic status of your family?", the responses ranged from 1 = *much below the average* to 5 = *much above the average*).

Data Analysis

Linear mixed models (IBM SPSS 27) were used to analyze changes in target persons' and partners' body fat percentage and energy-dense food intake up to the 36-week follow-up. Assuming small-to-medium effects of ς^2 = 10, a power of .95, p = .05, four experimental conditions, and the effects of potential confounders (e.g., gender), the sample should include 285 participants (obtained with G*Power calculator). All missing data were accounted for using the full information maximum likelihood method.

To examine between-condition differences of participants' dependent variables, we modelled three dummy-coded planning conditions as predictors, with the control condition as the reference group. To model effects over time, a Time variable was included as a predictor, with the following coding: "0" for baseline (T0), "9" for the 9-week follow-up (T3), and "36" for the 36-week follow-up (T4).

We conducted two sets of main analyses: (1) in the first set, the effects were tested by comparing participation in any planning intervention (collapsing all different planning conditions into one group) with the control group condition, additionally, Time, and one interaction between Time and PA planning condition were added as predictors; (2) in the second set of analyses, the effects were tested across the four groups, Time, and interactions between Time and the three planning conditions were added as predictors. Random effects of Time and intercepts were specified. Because models for energy-dense food intake conducted with random Time effects did not converge, random Time effects were excluded from these equations. The true R^2 (the squared correlation between the actual outcome and the outcome predicted by fixed effects; Hoffman, 2015) was computed to estimate the size of total effects.

Sensitivity analyses were conducted controlling for grand-mean centered age, MVPA at T0, education, and economic status and dummy-coded gender ("1" for male, "0" for female). Additionally we conducted sensitivity analyses for body fat (T4 as the outcome) with values of energy-dense food intake at T0 and T3 as covariates (see Table S5 and S6).

Results

Preliminary Results: Attrition Patterns, Randomization Checks, and Correlations

Attrition analyses indicated that target persons and partners who dropped out after T0 did not differ from those who completed the study in terms of baseline assessments of age, gender, MVPA, education, economic status, body fat level, and energy-dense food intake (all *F*s < 2.24, all *ps* > .135 and all $\chi s^2 < 0.72$, all *ps* > .40; see Supplemental Materials). Data for age, gender, education, economic status, body fat level, and energy-dense food intake were missing completely at random in case of partners, Little's MCARχ^2 (159) = 161.011, $p = .441$, but not in case of target persons, Little's MCARχ^2 (187) = 238.862, $p = .006$.

Randomization checks indicated no between-condition differences at T0 for target persons' and partners' gender, education, economic status, body fat level, and energy-dense food intake (all *F*s < 1.98, all *ps* > .118 and all $\chi s^2 < 1.59$, all *ps* > .66; see Supplemental

Materials). Across the conditions, there were no differences in the age of target persons, but partners differed in terms of age (see Supplemental Materials). Correlation analyses are reported in Table S2, Supplemental Materials. The average levels of participants' body fat and energy-dense food intake and effect size coefficients (d_{ppc2}) are reported in Table 1.

Effects of Physical Activity Planning Interventions on Body Fat

Effects of Participation in Any PA Planning Intervention

Target persons' body fat was not affected by the participation in any of the planning conditions (Table 2 and Figure 1). The results of the mixed model analysis in partners (Table 2 and Figure 1) showed no Time effects but significant interactions of Time x Planning condition (p = .021; the active control condition being the reference) up to the 36-week follow-up (T0-T4). Partners in the control condition showed an increase of 0.74% in their body fat, whereas body fat in partners in the planning conditions decreased by -0.84% (Tables 1 and 2). Additional sensitivity analyses, conducted for partners, controlled for age, gender, MVPA per day at T0, education, and perceived economic status, showed similar Time effects and Time x Planning condition interactions up to the 36-week follow-up (T0-T4, the active control condition being the reference; see Table S3 in Supplemental Materials).

Effects of the Three Types of a Planning Intervention

We did not find Time effects or the Time x Condition interaction for changes of body fat among target persons assigned to the individual, dyadic, or collaborative planning conditions, compared to the control condition (see Table 3 and Figure S3).

Regarding partners, we did not find Time effects, but we found a significant Time x Dyadic planning condition interaction (p = .007) up to the 36-week follow-up (T0-T4), when compared to partners of the control group. Partners in the control condition increased their body fat by 0.74%, but partners in the dyadic planning conditions showed a reduction in body fat by -0.85% (Table 1 and 3). Sensitivity analyses controlled for partners' age, gender, MVPA per day at T0, education, and perceived economic status resulted in similar Time effects and Time x Condition interactions up to the 36-week follow-up (T0-T4, the active control condition being the reference; see Table S4 in Supplemental Materials).

Effects of Physical Activity Planning Interventions on Energy-Dense Food Intake

Effects of Participation in Any PA Planning Intervention

We found Time effects for target persons ($p < .001$) and partners ($p = .041$). From baseline up to the 36-week follow-up, target persons and partners showed a reduced intake of energy-dense food of 0.07 and 0.04 points of the index, respectively (Table 2 and Figure 1).

The results for target persons' and partners' mixed models analyses (Table 2) showed no significant Time x Planning condition interactions in models explaining changes in energy-dense food intake up to the 36-week follow-up (T0-T4), compared to the active control condition. However, there was a trend for an interaction between Time and any PA planning condition ($p = .067$) for target persons. The decrease in energy-dense food intake among target persons assigned to any PA planning condition tended to be smaller (decrease by 0.06 points of the index) than the decrease of 0.09, observed in in the control condition. Sensitivity analyses conducted for target persons and partners, showed similar Time effects and Time x Planning condition interactions from T0 to T4 (see Table S3 in Supplemental Materials).

Effects of the Three Types of Planning Intervention

Analyses conducted for the three types of planning separately indicated Time effects for target persons ($p < .001$) and partners ($p = .041$). Compared from baseline to the 36-week follow-up, target persons and partners showed a decrease in the energy-dense food intake of 0.07 and 0.04 points of the index, respectively (Table 3 and Figure S4).

A significant Time x Individual planning interaction ($p = .014$) was found up to the 36-week follow-up (the active control condition being the reference). We observed a larger decrease (0.09 points of the index) in the energy-dense food intake in target persons of the control condition and a smaller decrease (0.03 points of the index) in the intake in target persons of the individual planning condition (Tables 1 and 3). Sensitivity analyses showed similar Time effects and Time x Condition interactions up to the 36-week follow-up (the active control condition being the reference; see Table S4 in Supplemental Materials).

We did not find significant interactions between Time and the specific planning conditions in partners up to the 36-week follow-up (the active control condition being the reference; Tables 1 and 3; for sensitivity analysis see Table S4 in Supplemental Materials).

Discussion

The findings of our study suggest that participating in the PA planning interventions did not result in changes in body fat among target persons; however, partners participating in the PA planning interventions reduced their body fat, whereas partners in the control group increased their body fat (a mean difference of 1.58%). This effect was mainly due to body fat reductions in partners from the dyadic planning condition. Both target persons and their partners, participating in either PA planning interventions or control group procedures, significantly reduced their energy-dense food intake, assessed up to the 36-week follow-up. However, target persons participating in the individual PA planning had a significantly smaller reduction in energy-dense food intake compared to target persons from the control group. We observed a statistical trend (p = .067) among target persons indicating that taking part in any PA planning interventions resulted in a smaller reduction in energy-dense food intake, compared to taking part in the control (education).

The small reduction in body fat among partners participating in the PA planning intervention (in particular, the dyadic "we-for-me" planning) is similar in size to changes in body fat following engagement in a PA training (e.g., a reduction of 1.46% after resistance training; Wewege et al., 2021). Previous analyses conducted in the same dataset indicated an accelerometer-measured increase in MVPA minutes among partners involved in the dyadic planning intervention (Kulis et al., 2022). Thus, the change in body fat observed among partners is consistent with their MVPA changes. Importantly, in the "we-for-me" dyadic PA planning intervention, partners were not the target of the intervention, but were instructed to support target persons during the planning process. Our findings may indicate a ripple effect.

The reduction in body fat among partners may be explained in the context of the specificity of dyadic planning intervention and the specificity of the enrolled sample. Compared to partners, target persons were more likely to be recommended to change their MVPA, have chronic diseases, or overweight/obesity. Therefore, enrolled dyads were likely to perform self-defined roles of "the target person/patient" and "the supporting partner" in their daily life. The roles assigned during the dyadic intervention were likely to fit the roles outside of the intervention setting. Dyadic planning involves social exchange processes, such as provision and receipt of social support, social control, rewarding, and so forth (Berli et al., 2018; Burkert et al., 2011; J. Keller et al., 2020; Knoll et al., 2017). To model a change in target persons, partners may decide to take up a change in their own behaviors (such as MVPA) and this may contribute to a change in their body composition. This ripple effect may occur as a result of partners "just" being engaged in supporting the process of behavior change (MVPA uptake) of the target person (Berli et al., 2018).

Our study suggests a ripple effect of PA interventions on partners' body fat reduction and provides support for the dyadic models of health behavior change. These models suggest that the relationship factors, beliefs, and behaviors of one member of the dyad influence beliefs and behaviors of the other member (Huelsnitz et al., 2022; Pietromonaco et al., 2013). Consistent with these approaches, ripple effects of behavior change interventions on health outcomes may occur in dyads.

A lack of a reduction in body fat among target persons may be explained by a trend for a smaller reduction in the energy-dense food intake among target persons in PA planning groups (a significant effect in the individual “I-for-me” PA planning group), compared to a larger reduction among control group participants. It is possible that self-regulatory efforts related to introducing a change in MVPA resulted in excessive demand for self-control resources and limited target persons’ abilities to achieve another behavioral goal, that is a reduction of energy-dense food intake (Hagger et al., 2010). Consequently, there was a compensatory effect of the attempt to change MVPA on energy-dense food intake. The compensatory effect may be one of the causes of a lack of a significant reduction in body fat among target persons assigned to PA planning interventions.

The trend for a compensatory effect was found for target persons only, whereas it was not observed among the partners. Again, it may be explained by the specificity of the type of enrolled dyads. At baseline, target persons were not meeting PA guidelines and/or they were recommended to change their behavior because of a chronic illness (e.g., type 2 diabetes or cardiovascular disease). It is possible that among such individuals energy-dense food intake take a form of strong habits, difficult to change through deliberate regulatory efforts (Gardner, 2015). Due to the strength of habits, a lot of self-regulatory efforts might be excreted to adopt regular MVPA, and this action might deplete the target persons’ self-regulatory resources in a way that their ability to self-regulate another behavior (energy-dense food intake) is reduced (Hagger et al., 2010). In contrast, the partners were less likely to have obesity or chronic disease, and thus, their self-regulatory resources were less depleted even if they invested some of their self-regulatory efforts to increase their MVPA levels.

The findings suggesting a trend for a compensatory effect of PA planning on energy-dense food intake among target persons but not among partners may shed some light on inconsistent findings in research on a spillover effect (Sarma et al., 2019). A spillover effect may be more likely if individuals are healthy, behaviors are less habitual and self-regulation is not depleted by strenuous efforts to change strong habits or manage other health-related tasks due to a chronic illness. A lack of a spillover effect (or even a compensatory effect) may be more likely if the enrolled individuals are motivated, yet their self-regulation is depleted by efforts invested in a change of habits or managing tasks related to a chronic illness. Future research on spillover, compensatory, or ripple effects should account for the type of the population enrolled (i.e., other self-regulatory tasks managed) and habit strength.

Last but not least, the trend for a compensatory effect has to be considered in the context of the reduction in energy-dense food intake across the study groups. Similar effects, indicating a reduction in energy-rich food intake across experimental and control groups, were found in research enrolling sedentary population (Dutton et al., 2008). It should be noted that the trend for the compensatory effect in the study does not mean an increase in energy-dense food intake, but a smaller reduction in intake, compared to the reduction in the control group.

The study has several limitations. The majority of participants were people with higher education and medium or higher economic status, which limits any generalizations. The results for the compensatory effects for all three planning groups combined together represent only statistical trends for effects; therefore, respective conclusions are tentative. A more thorough evaluation of food intake (Halliday et al., 2017), accounting for food other than energy-dense snacks/drinks would allow for more nuanced analyses. Future studies may use additional measurement points spanning a shorter time period to provide better insights into dyadic, collaborative, and individual processes of spillover, compensation, and ripple effects.

Our study is among the first showing the complexity of ripple effects and spillover/compensation effects in the dyads participating in a self-regulatory intervention, focusing on PA planning. The associations were found for specific dyads, including target persons being more likely than partners to report health issues such as obesity, cardiovascular disease, or type 2 diabetes. Partners, in turn, were accompanying and supporting the target persons in the process of changing their lifestyles. The ripple effect of the PA (dyadic) planning intervention on partners' body fat was found. The target persons taking part in the PA planning intervention did not reduce their body fat, and the reduction in energy-dense food intake tended to be smaller after a PA planning intervention (significantly smaller than in the individual PA planning group), compared to target persons in the control (PA, SB, and healthy diet education) condition. This behavior change pattern may suggest a compensatory rather than spillover effect among target persons.

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Disclosure statement

The authors declare no competing interests.

Data availability statement

Raw data and outputs of all analyses are available at Open Science Framework (https://osf.io/va8h3/?view_only=5cba896510e541f08f2a8e138ebdf31c).

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Table 1

Target Persons' and Partners' Body Fat and Energy-Dense Food Intake: Descriptive Statistics, Effects Sizes, Intraclass Correlation Coefficients

Dependent variables	Measurement	Individual planning condition (*n* = 82)	Dyadic planning condition (*n* = 83)	Collaborative planning condition (*n* = 79)	Control condition (*n* = 76)	All planning conditions (*n* = 244)	Total (*n* = 320)
		M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Target Persons' Body Fat	T0	32.04 (10.50)	31.68 (9.37)	31.76 (8.97)	32.90 (8.83)	31.83 (9.59)	32.08 (9.41)
	T4	30.77 (10.09)	30.70 (8.61)	30.54 (9.15)	32.44 (8.24)	30.67 (9.23)	31.09 (9.02)
	d_{ppc2} effect size coefficient (between experimental and control groups)	-0.08	-0.06	-0.09		-0.07	
	ICC	0.90	0.86	0.88	0.88	0.88	0.87
Partners' Body Fat	T0	29.31 (10.25)	25.86 (8.38)	28.73 (9.92)	28.08 (9.67)	27.95 (9.62)	27.98 (9.62)
	T4	28.57 (9.91)	25.01 (8.46)	28.07 (8.59)	28.82 (8.90)	27.11 (9.11)	27.53 (9.07)
	d_{ppc2} effect size coefficient (between experimental and control groups)	-0.15	-0.18	-0.14		-0.16	
	ICC	0.92	0.91	0.87	0.91	0.91	0.90
Target Persons' Energy-Dense Food Intake	T0	0.25 (0.32)	0.22 (0.18)	0.29 (0.35)	0.25 (0.22)	0.25 (0.29)	0.25 (0.28)
	T4	0.22 (0.24)	0.17 (0.14)	0.17 (0.15)	0.16 (0.12)	0.19 (0.18)	0.18 (0.17)
	d_{ppc2} effect size coefficient (between experimental and control groups)	0.22	0.20	-0.10		0.11	
	ICC	0.31	0.38	0.22	0.28	0.28	0.26
Partners' Energy-Dense Food Intake	T0	0.21 (0.18)	0.22 (0.20)	0.23 (0.21)	0.26 (0.29)	0.22 (0.19)	0.23 (0.22)
	T4	0.17 (0.13)	0.20 (0.22)	0.18 (0.23)	0.21 (0.23)	0.19 (0.18)	0.19 (0.21)
	d_{ppc2} effect size coefficient (between experimental and control groups)	0.04	0.12	0.00		0.05	
	ICC	0.23	0.46	0.41	0.39	0.39	0.40

Note. d_{ppc2} effect size coefficient (between experimental and control groups): the coefficient for repeated measures designs, weighting for the difference of the pre-post sample sizes, pre-post means and standard deviations in both the respective experimental group and the control group (Morris, 2008). T0 = baseline; T4 = 36-week follow-up; Body Fat = body fat percentage; Energy-Dense Food Intake = Energy-Dense Food Index; ICC = Intraclass correlation coefficient. For sample sizes at each measurement point see Supplemental Materials, Figure S1.

Table 2

Multilevel Model Estimates for Target Persons' and Partners' Body Fat and Energy-Dense Food Intake Over 36 Weeks in Any Planning Condition, and the Control Condition as the Reference Group

	Target Persons' Body Fat			Target Persons' Energy-Dense Food Intake			Partners' Body Fat			Partners' Energy-Dense Food Intake		
Indicators included in model	Est *(SE)*	*p*	CI_{95} Lower Upper	Est *(SE)*	*p*	CI_{95} Lower Upper	Est *(SE)*	*p*	CI_{95} Lower Upper	Est *(SE)*	*p*	CI_{95} Lower Upper
Fixed effects[a]						36-week follow-up						
Intercept (Control condition)	**32.26** **(1.07)**	**<.001**	**30.16** **34.36**	**0.25** **(0.02)**	**<.001**	**0.21** **0.30**	**28.17** **(1.07)**	**<.001**	**26.07** **30.27**	**0.27** **(0.02)**	**<.001**	**0.23** **0.32**
Time	-0.02 (0.02)	.259	-0.05 0.01	**>-0.01** **(<0.01)**	**<.001**	**>-0.01** **>-0.01**	0.02 (0.01)	.110	-0.01 0.05	**>-0.01** **(<0.01)**	**.041**	**>-0.01** **-6.14**
Planning condition	-0.58 (1.23)	.636	-2.99 1.83	-0.03 (0.03)	.210	-0.08 0.02	-0.45 (1.23)	.714	-2.86 1.96	*-0.05* *(0.03)*	*.059*	*-0.10* *<0.01*
Time x Planning condition	>-0.01 (0.02)	.797	-0.04 0.03	*<0.01* *(<0.01)*	*.067*	*>-0.01* *<0.01*	**-0.04** **(0.02)**	**.021**	**-0.07** **-0.01**	<0.01 (<0.01)	.591	>-0.01 <0.01
Random effects[a]												
Intercept	**86.02** **(6.98)**	**<.001**	**73.37** **100.84**	**0.01** **(<0.01)**	**.009**	**<0.01** **0.02**	**84.58** **(6.99)**	**<.001**	**71.94** **99.45**	**0.02** **(<0.01)**	**<.001**	**0.02** **0.03**
Time	**0.02** **(<0.01)**	**<.001**	**0.01** **0.03**				**0.01** **(<0.01)**	**.008**	**<0.01** **0.02**			
Intercept and time	**-0.36** **(0.09)**	**<.001**	**-0.54** **-0.19**				**-0.23** **(0.08)**	**.005**	**-0.39** **-0.07**			
AR1 rho	**-0.97** **(0.27)**	**<.001**	**-1.00** **1.00**	**0.29** **(0.08)**	**<.001**	**0.12** **0.44**	**-0.58** **(0.21)**	**.006**	**-0.86** **-0.04**	0.08 (0.09)	.362	-0.09 0.25

Note. a = for 36-week follow up models: random Time and intercept and fixed effects or only intercept and fixed effects were modelled; 36-week follow-up = change between Time 0 and Time 4 when controlled for Time 3 (9-week follow up); Intercept = baseline respective dependent variable assessment in control condition; Time = change over time in all conditions; Planning condition = any planning condition (collapsing individual, dyadic, and collaborative planning conditions into one group); Body Fat = body fat percentage; Energy-Dense Food Intake = Energy-Dense Food Index; Est = estimate; CI_{95} = Lower and Upper levels of 95% Confidence Interval. To model effects over time, a Time variable was included as a predictor, with the following coding: "0" for baseline, "9" for the 9-week follow-up, and "36" for the 36-week follow-up. For sample sizes at each measurement point see Figure S1. Bold coefficients represent significant relationships. Coefficients in italics represent statistical trends ($p < .10$). Values <0.01 in the table represent values such as 0.003, but larger than 0. Values > -0.01 in the table represent values such as -0.001 but smaller than 0. For target persons' body fat levels up to the 36-week follow-up: true $R^2 < .01$; for target persons' energy-dense food intake up to the 36-week follow-up: true $R^2 = .01$. For partners' body fat levels up to the 36-week follow-up: true $R^2 < .01$; for partners' energy-dense food intake up to the 36-week follow-up: true $R^2 = .01$.

Table 3

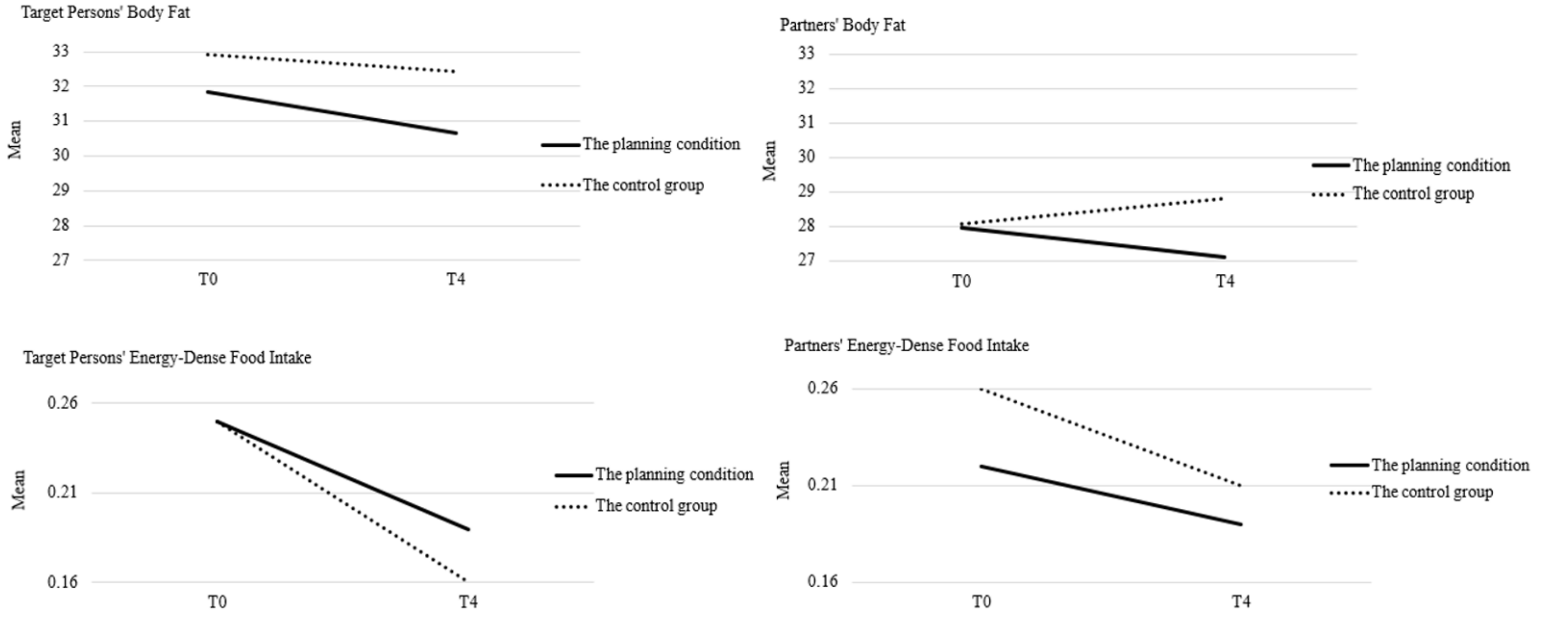
Multilevel Model Estimates for Target Persons' and Partners' Body Fat and Energy-Dense Food Intake Over 36 Weeks in the Respective Planning Conditions, the Control Condition as the Reference Group

	Target Persons' Body Fat			Target Persons' Energy-Dense Food Intake			Partners' Body Fat			Partners' Energy-Dense Food Intake		
Indicators included in model	Est *(SE)*	*p*	CI_{95} Lower Upper	Est *(SE)*	*p*	CI_{95} Lower Upper	Est *(SE)*	*p*	CI_{95} Lower Upper	Est *(SE)*	*p*	CI_{95} Lower Upper
Fixed effects[a]	36-week follow-up											
Intercept (Control condition)	**32.26 (1.07)**	**<.001**	**30.15 34.37**	**0.25 (0.02)**	**<.001**	**0.21 0.30**	**28.16 (1.06)**	**<.001**	**26.08 30.26**	**0.27 (0.02)**	**<.001**	**0.23 0.32**
Time	-0.02 (0.02)	.263	-0.05 0.01	**>-0.01 (<0.01)**	**<.001**	**>-0.01 >-0.01**	0.02 (0.01)	.110	-0.01 0.05	**>-0.01 (<0.01)**	**.041**	**>-0.01 -5.98**
Individual planning condition	-0.29 (1.23)	.845	-3.24 2.65	-0.03 (0.03)	.305	-0.09 0.03	1.13 (1.48)	.445	-1.76 4.03	-0.05 (0.03)	.115	-0.11 0.01
Dyadic planning condition	-0.37 (1.48)	.803	-3.29 2.55	*-0.05 (0.03)*	*.086*	*-0.12 0.01*	-2.29 (1.47)	.120	-5.19 0.60	*-0.06 (0.03)*	*.081*	*-0.12 0.01*
Collaborative planning condition	-1.10 (1.51)	.464	-4.07 1.86	-0.01 (0.03)	.739	-0.07 0.05	-0.14 (1.50)	.926	-3.09 2.81	-0.04 (0.03)	.188	-0.11 0.02
Time x Individual planning condition	-7.40 (0.02)	.997	-0.04 0.04	**<0.01 (<0.01)**	**.014**	**<0.01 <0.01**	-0.03 (0.02)	.179	-0.07 0.01	<0.01 (<0.01)	.739	>-0.01 <0.01
Time x Dyadic planning condition	-0.02 (0.02)	.453	-0.06 0.03	<0.01 (<0.01)	.114	>-0.01 <0.01	**-0.05 (0.02)**	**.007**	**-0.09 -0.01**	<0.01 (<0.01)	.352	>-0.01 <0.01
Time x Collaborative planning condition	<0.01 (0.02)	.871	-0.04 0.05	<0.01 (<0.01)	.647	>-0.01 <0.01	-0.03 (0.02)	.120	-0.07 0.01	5.10 (<0.01)	.961	>-0.01 <0.01
Random effects[a]												
Intercept	**86.47 (7.04)**	**<.001**	**73.72 101.43**	**0.01 (<0.01)**	**.007**	**<0.01 0.02**	**83.55 (6.93)**	**<.001**	**71.02 98.30**	**0.02 (<0.01)**	**<.001**	**0.02 0.03**
Time	**-0.36 (0.09)**	**<.001**	**-0.54 -0.19**				**-0.24 (0.08)**	**.003**	**-0.40 (-0.08)**			
Intercept and time	**0.02 (<0.01)**	**<.001**	**0.01 0.03**				**0.01 (<0.01)**	**.008**	**<0.01 0.02**			
AR1 rho	**-0.96 (0.27)**	**<.001**	**-1.00 1.00**	**0.29 (0.08)**	**<.001**	**0.12 0.44**	**-0.57 (0.21)**	**.007**	**-0.85 -0.04**	0.08 (0.09)	.338	-0.09 0.25

Note. a = for 36-week follow up models: random Time and intercept and fixed effects or only intercept and fixed effects were modelled; 36-week follow-up = change between Time 0 and Time 4 when controlled for Time 3 (9-week follow up); Intercept = baseline respective dependent variable assessment in control condition; Time = change over time in all conditions; Body Fat = body fat percentage; Energy-Dense Food Intake = Energy-Dense Food Index; Est = estimate; CI_{95} = Lower and Upper levels of 95% Confidence Interval. To model effects over time, a Time variable was included as a predictor, with the following coding: “0” for baseline, “9” for the 9-week follow-up, and “36” for the 36-week follow-up. For sample sizes at each measurement point see Figure S1. Bold coefficients represent significant relationships. Coefficients in italics represent statistical trends ($p < .10$). Values <0.01 in the table represent values such as 0.003, but larger than 0. Values > -0.01 in the table represent values such as -0.001 but smaller than 0. For target persons’ body fat levels up to the 36-week follow-up: true $R^2 < .01$; for target persons’ energy-dense food intake up to the 36-week follow-up: true $R^2 = .02$. For partners’ body fat levels up to the 36-week follow-up: true $R^2 = .02$; for partners’ energy-dense food intake up to the 36-week follow-up: true $R^2 = .01$.

Figure 1

Target persons' and Partners' Changes in Body Fat (the Top Panel) and Energy-Dense Food Intake (the Bottom Panel) Across Any Planning Condition and the Control Condition



Note: T0 = baseline, a week prior to the experimental procedures; T4 = 36-week follow-up; the planning condition = any planning condition (collapsing individual, dyadic, and collaborative planning conditions into one group). The top panel: Figures present the average percentage of body fat among target persons and partners. The bottom panel: Figures present the average energy-dense food intake (mean item responses from the Energy-Dense Food Index) by target persons and partners.

Physical Activity Planning Interventions, Body Fat and Energy-Dense Food Intake in Dyads: Ripple, Spillover, or Compensatory Effects?

Supplemental Materials

Supplemental materials include:

– additional information about participants recruitment (Description of the Participants' Recruitment),
– additional information on experimental and control group procedures among target person-partner dyads (Description of Experimental Procedures),
– results of preliminary analyses: attrition analyses, attrition analyses for accelerometry data, randomization check (Results),
– participant flow over measurement points (Figure S1),
– graphic information about study design and procedures (Figure S2),
– changes over time in average body fat level for individual, dyadic, and collaborative planning conditions and control condition (Figure S3)
– changes over time in average self-reported energy-dense food intake for individual, dyadic, and collaborative planning conditions and the control condition (Figure S4)
– target persons' and partners' characteristics (Table S1),
– relations between respective indicators included in models (Table S2),
– findings of the sensitivity analyses: target persons' and partners' models of change over time for respective experimental conditions with additional sociodemographic and MVPA at T0 and control condition as a reference group (Table S3),
– findings of the sensitivity analyses: target persons' and partners' models of change over time for any planning condition with additional sociodemographic and MVPA at T0 and control condition as a reference group (Table S4),

- findings of the sensitivity analyses: target persons' and partners' models of change over time for any planning condition controlled for energy-dense food intake at T0 and T3 and control condition as a reference group (Table S5),
- findings of the sensitivity analyses: target persons' and partners' models of change over time for respective experimental conditions controlled for energy-dense food intake at T0 and T3 and control condition as a reference group (Table S6),
- syntaxes for the main analyses.

Description of the Participants' Recruitment

According to Kulis et al. (2022), the target sample included adults from the general population who: (1) did not meet the WHO (2010, 2020b) moderate-to-vigorous physical activity (MVPA) recommendations valid for the time of data collection, and/or were recommended to increase their MVPA levels due to cardiovascular diseases/type 2 diabetes; and (2) had an adult partner willing to participate with them in this study. The study inclusion criteria were: (1) based on self-reported information obtained during the recruitment, a dyad was included if the target person was performing < 150 MVPA minutes per week, in line with the WHO (2010, 2020b) recommendations (valid for the date when data collection was initiated) and/or had a cardiovascular disease and/or type 2 diabetes (and received recommendations from a physician or rehabilitation specialist to increase their PA levels); (2) target persons reported at least a moderate intention to perform regular PA; and (3) a target person and their dyadic partner were in a romantic, familial, amicable, and/or working relationship for at least one year and meeting regularly (at least several times a week). Participants were recruited with strategies such as advertisements in newspapers or social media, in-person recruitment at public events, in health care organizations, senior clubs, and non-governmental organizations. In case both dyad members did not meet PA guidelines and none had a cardiovascular disease or type 2 diabetes, the roles of the target person and partner were self-assigned by the dyad. Otherwise, the study staff proposed the role of the target person to the individual who did not meet PA guidelines and/or was recommended by a physician to increase their PA.

Description of Experimental Procedures (see also Kulis et al., 2022)

A study protocol (in English) is available at the website providing the details of the trial registration, see ClinicalTrials.gov, no. NCT03011385, see also Open Science Framework: https://osf.io/va8h3/?view_only=5cba896510e541f08f2a8e138ebdf31c.

To secure the fidelity of the delivery of the intervention and control group procedures (in line with the protocol), a standard supervision procedure was conducted. The supervision was delivered to all experimenters and included a discussion with a representative of the supervisory team (four researchers); a discussion was conducted during the supervisory meetings, conducted after delivering each face-to-face intervention session and once after the booster calls. The discussion included reports of what happened during the intervention/control group procedures, including any problems occurring, and a brief reminder of the procedures planned for the subsequent assessment/intervention delivery. There were no major deviations from the protocol. The intervention materials were not tailored.

The following behavior change techniques (BCTs; Michie et al., 2013) were used in the three planning conditions: action planning, barrier identification, prompting self-talk, social support, relapse prevention/coping planning. Applications of all BCTs included references to collaborative, dyadic, or individual planning, respectively.

Face-to-face format was chosen based on previous research on planning interventions among people with type 2 diabetes (Knäuper et al., 2018) or overweight/obesity (Luszczynska et al., 2007). The weekly contact schedule for planning interventions was based on previous research, using weekly planning sheets in the interventions (Knäuper et al., 2018; Luszczynska et al., 2007). Inclusion of at least two planning sessions was based on previous research testing booster planning sessions (Chapman & Armitage, 2010; Scholz et al., 2013).

Education procedures (included in the active control and planning groups) comprised physical activity, sedentary behavior, and nutrition education, added to address the needs of participants with cardiovascular diseases, type 2 diabetes, or overweight (see Knäuper et al., 2018; Luszczynska et al., 2007).

Control Condition

Target persons and their dyadic partners from the control group and the three planning groups took part in education sessions referring to healthy nutrition (T0) and physical activity (PA) with sedentary behaviors (SB; T1, T2, T3). A face-to-face, individually delivered education included a discussion of the guidelines, and a leaflet presentation (to be taken home, target persons and their partners were also informed that the educational materials are available at the research project website).

The healthy nutrition education was based on World Health Organization (WHO) standards for the respective behaviors (WHO, 2010, 2020a, 2020b). The healthy nutrition education (T0) included: (1) a definition of a healthy diet; (2) a set of guidelines that helped with implementing the principles of healthy eating; (3) definitions and examples of calculating the basic metabolic rate, total metabolic rate, energy balance and, body mass index; (4) a Healthy Eating Plate presentation (Castillo et al., 2018) with a detailed description of each product group; (5) detailed recommendations for a healthy diet for different age groups.

The PA education (T1, T2, T3) included: (1) a definition of PA types and intensities; (2) World Health Organization (WHO, 2010, 2020b) PA recommendations; (3) instructions on how to distinguish between the moderate and vigorous intensity of PA; (4) results of scientific research on the positive effects of PA on physical and mental health; (5) tips on how to start being active; (6) examples of a weekly PA schedule; (7) detailed recommendations for

PA according to different age groups and various chronic diseases (such as cardiovascular disease or type 2 diabetes).

Sedentary behavior (SB) education (T1, T2, T3) included: (1) definition of SB; examples of SB; (2) results of the scientific research on the negative impact of SB on health; (3) definition and examples of active breaks; (4) examples of ways to reduce SB.

Additionally, booster call sessions (three after T2) included the repetition of PA and SB recommendations, followed by healthy nutrition recommendations.

There are several reasons for including nutrition education and SB education into the education for all participants: (1) a pilot study conducted with target persons (a target population) including adults with cardiovascular diseases, type 2 diabetes, and overweight/obesity (also constituting a majority of the population recruited in the study) indicated that inclusion of a nutrition education and SB education would increase acceptability and feasibility of the education component of the intervention and control group procedures; (2) this registered trial has the body mass index as one of the secondary outcomes; a nutrition education was included to obtain a similar level of nutrition knowledge across the study groups and participants and thus, reduce the potential effects of knowledge on subsequent energy intake and expenditure behaviors, and subsequently, body mass; (3) this trial also has SB as one of the secondary outcomes; a SB education was included to obtain a similar level of respective knowledge across the study groups and participants and thus, reduce the potential effects of knowledge on subsequent SB assessment; (4) in the real-world setting, behavioral change programs are usually multicomponent, because addressing more than one behavior results in larger changes in health and behavioral outcomes (for a meta-analysis see Wilson et al., 2015); (5) addressing PA and nutrition results in larger changes in one of the secondary outcomes, that is body mass (for a meta-analysis see Lim et al., 2015).

Collaborative Planning Condition

At T0, target persons and their dyadic partners were introduced to a nutrition education. Then, at T1, T2, and T3, a PA and SB education was provided, these procedures were the same as in the control condition. Next, at T1, T2, and T3, a face-to-face collaborative planning intervention took place (its duration was about 11 minutes). First, the study personnel informed target persons and dyadic partners that: “Research to date suggests that despite intending to undertake regular PA, many people fail to do so. To give yourself the best chance of succeeding, it seems that it can be helpful to make very specific plans with a partner (e.g., husband, wife, girlfriend, boyfriend, housemate) about when, where, and how you will perform a PA together.” Second, target persons and dyadic partners were introduced to planning sheets. Next, target persons and their partners were asked to think about different PA types that they found enjoyable and feasible for both of them. Then, they wrote up on the planning sheets a joint plan on “when,” “where,” and “how” they could do these activities in the following week (at the same time, they were encouraged to plan the recommended amount of MVPA). Overall, target persons and their partners were asked to form at least one specific collaborative action plan for the following week (7 days).

At the end of filling in the planning sheet, both participants were asked to answer a 2-item checklist to ensure that plans were formed appropriately: “Does your plan identify physical activities which are appropriate for you and your partner? Does your plan identify days and hours when you will be physically active together?”. If the answer was “no”, participants were asked to adjust the plan accordingly. Finally, when the joint plan had been prepared, target persons and dyadic partners were asked to form coping plans (Sniehotta et al., 2006). Both participants were informed that: “A lot of barriers might hamper you from being regularly physically active or executing your PA plan. Some of them you can anticipate (e.g., medical appointment) but others not (e.g., health issues, work/school duties). Together with your partner, prepare the additional plan (“plan B”), where you anticipate how to cope with potential barriers. An example of such coping plan is: “if situation X appears, then you and your partner will cope with it by doing Y.” One example of a coping plan was provided. Then, participants were asked to discuss and write up to three potential barriers and respective coping responses in the “if… then…” format using a coping planning sheet. Overall, both participants were asked to form at least one complex collaborative coping plan for the following week. Again, plans were revised by the 2-item checklist to ensure that they were formed properly. In each collaborating planning condition, target persons and dyadic partners were asked to fill in their own planning form and checklist (so each participant had a copy of the joint plan). Similar procedures have been used in previous collaborative planning research (e.g., Prestwich et al., 2012) as well as in previous research on planning interventions (Knäuper et al., 2018; Luszczynska et al., 2007).

At T2, both participants were also handed three copies of the planning sheets, followed by a copy of the planning sheet after T3, and encouraged to plan together their PA in the three following weeks in order to discuss the implementation of the plans during the booster sessions.

The four booster phone calls (three sessions provided week by week after T2, and one session provided week after T3) included a reminder of a collaborative planning intervention. The study personnel called target persons and their partners. During the phone call, after the brief education component reminder (definitions and guidelines for PA and SB, and rules of healthy nutrition), the study personnel asked each of the participants about the implementation of the collaborative plans of PA in the previous week. Finally, both dyadic partners were encouraged to form specific collaborative plans for the following week and to prepare the coping plans using the four copies of planning sheets received after T2 and T3 (to be discussed during 3-weekly booster sessions after T2 and week after T3). Planning sheets between T2 and T3, and after T3 were similar to the face-to-face intervention and completed by both participants without the supervision of study personnel.

Dyadic Planning Condition

At T0, target persons and their dyadic partners were introduced to the nutrition education, and at T1, T2, and T3 to the PA and SB education. These procedures were the same as in the control condition. Next, at T1, T2, and T3 the face-to-face dyadic planning interventions took place (their duration was about 11 minutes). Target persons and their partners participated in the planning procedure jointly; however, they were asked to define "when," "where," and "how" the target persons would be physically active to meet the MVPA recommendations. At the same time, the dyadic partners' function was to support the plan formation, which would be enacted by participants. The introduction, examples of plans, action planning sheet, and coping planning sheet were analogous to the collaborative planning condition, but instructions were adapted to dyadic planning. Only the target persons were asked to fill in their planning form and the checklist for each plan. Overall, target persons were asked to form at least one specific dyadic action plan and at least one specific dyadic coping plan for the following week (7 days).

Similar procedures were used in previous dyadic planning research (e.g., Knoll et al., 2017) as well as in previous research on planning interventions (Knäuper et al., 2018; Luszczynska et al., 2007). As in the collaborative planning condition, three booster calls were conducted, whereas the conversations and plan formations were tailored to the dyadic planning condition (in addition to a reminder of the education, only target persons were asked about the implementation of the plans during the booster sessions, whereas dyadic partners were asked about providing the support for target persons in the formation of these plans).

Individual Planning Condition

At T0, target persons and their dyadic partners were introduced to the nutrition education and at T1, T2, and T3, to the PA and SB education. These procedures were the same as in the control condition. Next, at T1, T2, and T3, the face-to-face individual planning intervention took place (their duration was about 11 minutes). Target persons and their partners participated in the planning procedure jointly; however, they were completing the plans individually, referring to "when," "where," and "how" they would be physically active to meet the MVPA recommendations. Target persons and dyadic partners were not allowed to consult on their plans. The introduction, examples of plans, the action planning sheet, and coping planning sheet were analogous to the collaborative and dyadic planning conditions, but the instructions for both participants were adapted to individual planning. For each plan, target persons and their partners were asked to fill in their own planning form and the checklist. Overall, both participants in the individual planning condition were asked to form at least one complex individual action plan and at least one complex individual coping plan for the following week (7 days).

The procedures were based on planning interventions by Knäuper et al. (2018) and Luszczynska et al. (2007). Similar to the collaborative and dyadic planning conditions, three booster calls were conducted, whereas the conversations and plan formations were tailored to the individual planning condition (in addition to a reminder of the education, target persons and their partners were asked individually about their plans' implementation during the booster sessions).

Results

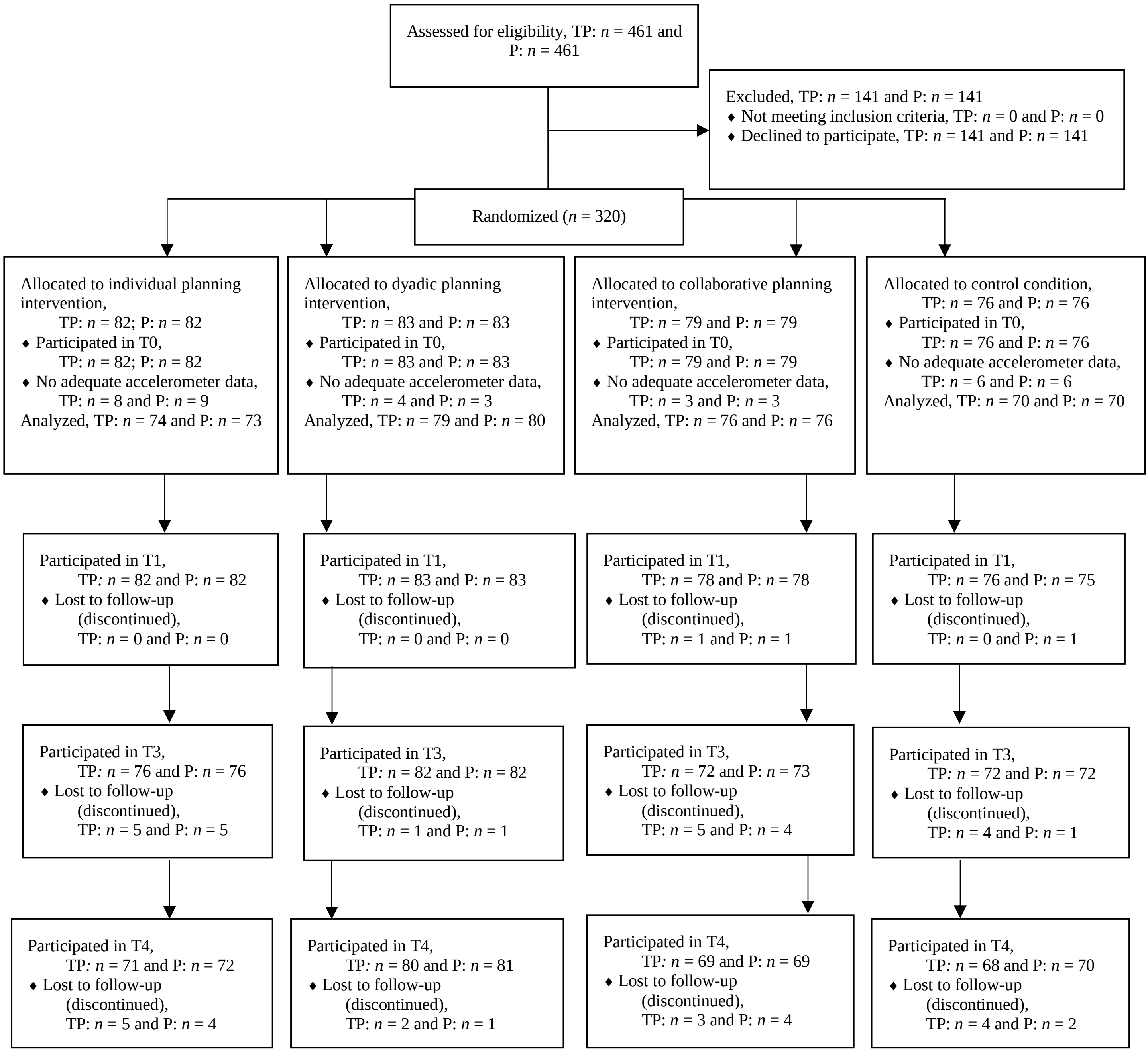
Attrition Analyses and Randomization Check

Attrition analyses indicated that participants who dropped out before T4 did not differ from completers in terms of target persons' age *F*(1, 319) = 2.242, *p* = .135, gender χ^2(1, *N* = 320) = 0.055, *p* = .815, perceived economic status *F*(1, 319) = 0.113, *p* = .737, years of education *F*(1, 319) = 0.982, *p* = .322, MVPA minutes/day *F*(1, 319) = 0.112, *p* = .738 at T0, and partners' age *F*(1, 319) = 0.429, *p* = .513, gender χ^2(1, *N* = 320) = 0.723, *p* = .395, perceived economic status *F*(1, 319) = 0.068, *p* = .795, years of education *F*(1, 319) = 0.280, *p* = .597, MVPA minutes/day *F*(1, 319) = 0.037, *p* = .847 at T0. There were no differences from completers in terms of target persons' body fat *F*(1, 304) = 0.749, *p* = .388 and energy-dense food intake *F*(1, 319) = 1.950, *p* = .164, and partners' body fat *F*(1, 304) = 0.358, *p* = .550 and energy-dense food intake *F*(1, 319) = 0.931, *p* = .335.

Sociodemographic covariates in the respective target persons' and partners' models did not differ across the four experimental conditions in terms of target persons' age *F*(3, 317) = 0.794, *p* = .498, gender χ^2(3, *N* = 320) = 1.589, *p* = .662, perceived economic status *F*(3, 317) = 0.929, *p* = .427, years of education *F*(3, 317) = 0.935, *p* = .424, *p* = .300, MVPA *F*(3, 317) = 1.170, *p* = .321, body fat *F*(1, 304) = 0.262, *p* = .853 and energy-dense food intake *F*(1, 319) = 0.893, *p* = .445, and partners' gender χ^2(3, *N* = 320) = 1.190, *p* = .755, perceived economic status *F*(3, 317) = 1.264, *p* = .287, years of education *F*(3, 317) = 1.339, *p* = .262, *p* = .300, MVPA *F*(3, 317) = 0.998, *p* = .394, body fat *F*(1, 304) = 1.975, *p* = .118 and energy-dense food intake *F*(1, 319) = 0.682 *p* = .263. There were differences between conditions in partners' age *F*(3, 317) = 2.920, *p* = .034, the between conditions analysis showed a statistical trend for differences (*p* = .056 and *p* = .085, respectively) among conditions, partners' in collaborative planning condition (*M* = 44.61, *SD* = 17.57) and in individual planning condition (M = 44.17, SD = 17.17) were older then partners in dyadic planning (M = 37.87, SD = 14.60).

Figure S1

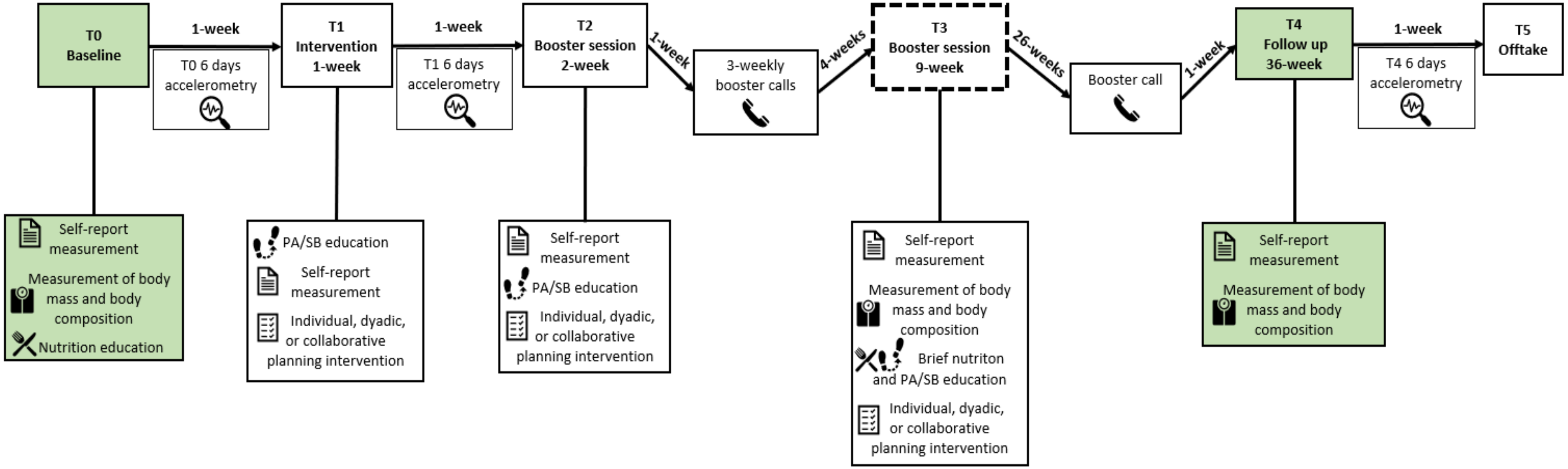
The Target Persons and Partners Flow Diagram



Note. TP = target persons; P = partners.

Figure S2

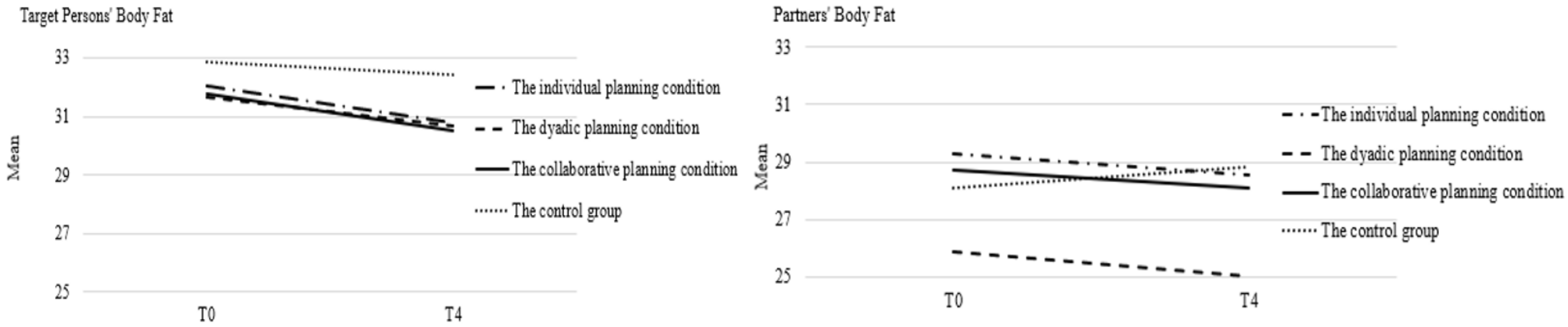
Study Design and Procedures



Note. PA = physical activity; SB = sedentary behaviors; T = time. The measurement points included in this study are marked in green color. Dashed lines indicate measurement point controlled in the models.

Figure S3

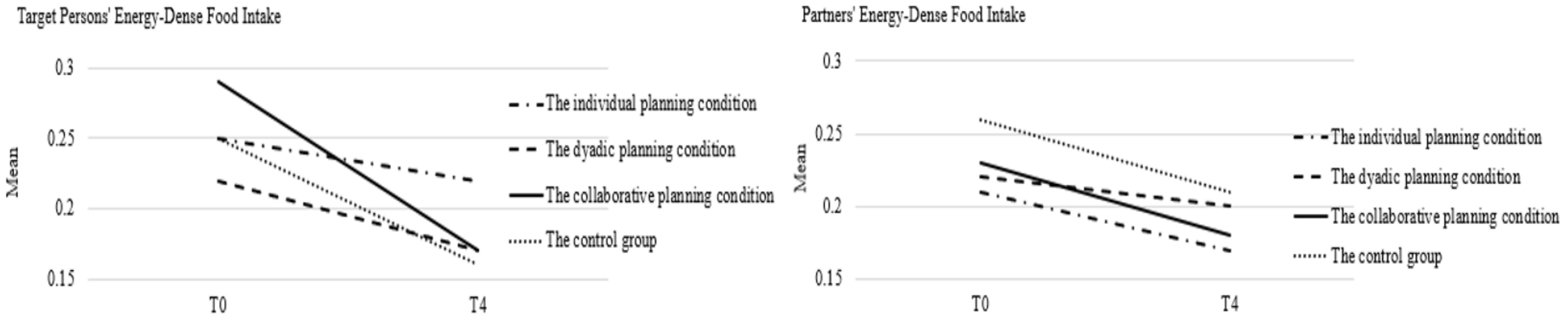
Target Persons' and Partners' Changes Body Fat Across the Experimental and Control Conditions



Note. T0 = baseline, a week prior to the experimental procedures; T4 = 36-week follow-up. Figures present the average percentage of body fat among target persons and partners.

Figure S4

Target Persons' and Partners' Changes in the Energy-Dense Food Intake Across the Experimental and Control Conditions



Note. T0 = baseline, a week prior to the experimental procedures; T4 = 36-week follow-up. Figures present the average energy-dense food intake (mean item responses from the Energy-Dense Food Index) by target persons and partners.

Table S1
Target Persons and Partners Descriptive Statistics

	Target Persons (*n* = 320)	Partners (*n* = 320)
Mean Age (*SD*)	43.86 (17.02)	42.32 (16.55)
Gender (%)		
Female	64.4	64.1
Male	35.6	35.9
Education (%)		
Primary education	2.2	1.3
High school degree	37.2	36.6
Vocational/post-secondary	3.1	5.3
University degree	57.5	56.8
Economic Status (%) compared to average for families in Poland		
Below average	5.6	6.9
Average	52.2	49.4
Above average	42.2	43.7
Marital status (%)		
Romantic relationship	79.0	79.3
Single/widowed/divorced	20.9	20.8
Mean BMI at T0 (*SD*)	28.00 (6.42)	25.68 (4.60)
Range: minimum/maximum	16.94/58.57	16.95/53.24
Diseases (%)		
CVD/type 2 diabetes	39.4	16.7
Other illnesses	27.2	24.5
Mean MVPA at T0 (*SD*)	73.38 (30.39)	81.89 (31.00)
Range: minimum/maximum	4.83 / 167.81	8.57 / 167.98

Note. *SD* = Standard deviation; BMI = Body Mass Index; CVD = Cardiovascular diseases; MVPA =moderate-to-vigorous physical activity

Table S2

Correlations Between the Study Variables

	Indicators	1	2	3	4	5	6	7	8	9
						Target Persons				
1	Body Fat [T0]	1	0.88***	-0.11	-0.06	0.56***	0.29***	-0.23***	-0.14*	-0.15**
2	Body Fat [T4]		1	-0.08	-0.09	0.52***	0.31***	-0.17**	-0.13*	-0.17**
3	Energy-Dense Food Intake [T0]			1	0.31***	-0.13*	-0.05	0.13*	-0.15**	>-0.01
4	Energy-Dense Food Intake [T4]				1	-0.11†	-0.05	0.09	-0.06	-0.05
5	Age					1	-0.04	-0.29***	-0.11†	-0.15**
6	Gender						1	-0.01	0.03	-0.18***
7	MVPA [T0]							1	-0.01	0.01
8	Education								1	0.13*
9	SES									1
	Indicators	1	2	3	4	5	6	7	8	9
						Partners				
1	Body Fat [T0]	1	0.90***	-0.07	-0.05	0.54***	0.54***	-0.11†	-0.14*	-0.22***
2	Body Fat [T4]		1	-0.03	-0.03	0.53***	0.54***	-0.13*	-0.09	-0.17**
3	Energy-Dense Food Intake [T0]			1	0.41***	-0.05	>-0.01	0.08	-0.09†	-0.14**
4	Energy-Dense Food Intake [T4]				1	0.04	-0.06	0.03	-0.14**	-0.06
5	Age					1	0.06	-0.20***	-0.11†	-0.22***
6	Gender						1	-0.01	0.06	-0.05
7	MVPA [T0]							1	-0.03	-0.01
8	Education								1	0.19***
9	SES									1

Note. * = <.05; ** = <.01; *** = <.001; † = a statistical trend, $p < .10$; T0 = baseline; T4 = 36-week follow-up; Body Fat = body fat percentage; Energy-Dense Food Intake = Energy-Dense Food Index; MVPA = moderate-to-vigorous physical activity; SES = perceived economic status.

Table S3

Multilevel Model Estimates for Target Persons' and Partners' Body Fat and Energy-Dense Food Intake and Controlled Variables (Age, Gender, MVPA per day at T0, Education, and Perceived Economic Status) Over 36 Weeks in Any Planning Condition and the Control Condition as the Reference Group

Indicators included in model	Target Persons' Body Fat			Target Persons' Energy-Dense Food Intake			Partners' Body Fat			Partners' Energy-Dense Food Intake		
	Est (*SE*)	*p*	CI_{95} Lower Upper	Est (*SE*)	*p*	CI_{95} Lower Upper	Est (*SE*)	*p*	CI_{95} Lower Upper	Est (*SE*)	*p*	CI_{95} Lower Upper
Fixed effects[a]						36-week follow-up						
Intercept (Control condition)	**34.18 (0.87)**	**<.001**	**32.48 35.89**	**0.25 (0.02)**	**<.001**	**0.20 0.29**	**31.32 (0.77)**	**<.001**	**29.81 32.83**	**0.27 (0.02)**	**<.001**	**0.22 0.31**
Time	-0.02 (0.02)	.253	-0.05 0.01	**>-0.01 (<0.01)**	**<.001**	**>-0.01 >-0.01**	0.02 (0.01)	.166	-0.01 0.05	**>-0.01 (<0.01)**	**.041**	**>-0.01 -6.14**
Planning condition	-0.23 (0.95)	.811	-2.09 1.64	-0.03 (0.03)	.188	-0.08 0.02	-0.14 (0.83)	.866	-1.78 1.50	*-0.05 (0.03)*	*.084*	*-0.10 0.01*
Time x Planning condition	0.01 (0.02)	.765	-0.04 0.03	*<0.01 (<0.01)*	*.067*	*>-0.01 <0.01*	**-0.03 (0.02)**	**.035**	**-0.07 >-0.01**	<0.01 (<0.01)	.591	>-0.01 <0.01
Age	**0.28 (0.02)**	**<.001**	**0.23 0.32**	**>-0.01 (<0.01)**	**.004**	**>-0.01 >-0.01**	**0.26 (0.02)**	**<.001**	**0.22 0.30**	>-0.01 (<0.01)	.553	>-0.01 <0.01
Gender	**-6.07 (0.81)**	**<.001**	**-7.65 -4.48**	0.02 (0.02)	.212	-0.01 0.06	**-9.45 (0.71)**	**<.001**	**-10.85 -8.05**	0.01 (0.02)	.767	-0.03 0.05
MVPA per day at T0	-0.02 (0.01)	.159	-0.04 0.01	<0.01 (<0.01)	.206	>-0.01 <0.01	-0.01 (0.01)	.250	-0.03 0.01	<0.01 (<0.01)	.320	>-0.01 <0.01
Education	**-0.37 (0.15)**	**.015**	**-0.66 -0.07**	**-0.01 (<0.01)**	**.006**	**-0.02 >-0.01**	**-0.44 (0.14)**	**.002**	**-0.73 -0.16**	**-0.01 (<0.01)**	**.019**	**-0.02 >-0.01**
SES	-0.25 (0.51)	.626	-1.25 0.75	>-0.01 (0.01)	.697	-0.03 0.02	-0.41 (0.45)	.359	-1.29 0.47	-0.02 (0.01)	.139	-0.05 0.01
Random effects[a]												
Intercept	**50.62 (4.24)**	**<.001**	**42.96 59.66**	**0.01 (<0.01)**	**.025**	**<0.01 0.02**	**36.69 (3.41)**	**<.001**	**30.59 44.02**	**0.02 (<0.01)**	**<.001**	**0.01 0.03**
Time	**0.02 (<0.01)**	**<.001**	**0.01 0.03**				**0.01 (<0.01)**	**.041**	**<0.01 0.02**			

Intercept and time	**-0.31 (0.08)**	**<.001**	**-0.46 -0.16**				*-0.11 (0.06)*	*.066*	*-0.23 0.01*			
AR1 rho	**-0.98 (0.26)**	**<.001**	**-1.00 1.00**	**0.29 (0.08)**	**<.001**	**0.13 0.45**	**-0.41 (0.20)**	**.037**	**-0.72 0.03**	0.08 (0.09)	.360	-0.09 0.25

Note. a = for 36-week follow up models: random Time and intercept and fixed effects or only intercept and fixed effects were modelled; 36-week follow-up = change between Time 0 and Time 4 when controlled for Time 3 (9-week follow up); Intercept = baseline respective dependent variable assessment in control condition; Time = change over time in all conditions; Planning condition = any planning condition (collapsing individual, dyadic and collaborative planning conditions into one group); Body Fat = body fat percentage; Energy-Dense Food Intake = Energy-Dense Food Index; SES = perceived economic status; Est = estimate; MVPA = moderate-to-vigorous physical activity; CI_{95} = Lower and Upper levels of 95% Confidence Interval. To model effects over time, a Time variable was included as a predictor, with the following coding: “0” for baseline (T0), “9” for the 9-week follow-up (T3), and “36” for the 36-week follow-up (T4). For sample sizes at each measurement point see Figure S1. Bold coefficients represent significant relationships. Coefficients in italics represent statistical trends ($p < .10$). Values <0.01 in the table represent values such as 0.003, but larger than 0. Values > -0.01 in the table represent values such as -0.001 but smaller than 0.

Table S4

Multilevel Model Estimates for Target Persons' and Partners' Body Fat and Energy-Dense Food Intake and Controlled Variables (Age, Gender, MVPA per day at T0, Education, and Perceived Economic Status) Over 36 Weeks in the Respective Planning Conditions and the Control Condition as the Reference Group

	Target Persons' Body Fat			Target Persons' Energy-Dense Food Intake			Partners' Body Fat			Partners' Energy-Dense Food Intake		
Indicators included in model	Est (*SE*)	*p*	*CI*$_{95}$ Lower Upper	Est (*SE*)	*p*	*CI*$_{95}$ Lower Upper	Est (*SE*)	*p*	*CI*$_{95}$ Lower Upper	Est (*SE*)	*p*	*CI*$_{95}$ Lower Upper
Fixed effects[a]						36-week follow-up						
Intercept (Control condition)	**34.17 (0.87)**	**<.001**	**32.46 35.88**	**0.25 (0.02)**	**<.001**	**0.20 0.30**	**31.31 (0.77)**	**<.001**	**29.80 32.82**	**0.27 (0.02)**	**<.001**	**0.22 0.31**
Time	-0.02 (0.02)	.256	-0.05 0.01	**>-0.01 (<0.01)**	**<.001**	**>-0.01 >-0.01**	0.02 (0.01)	.167	-0.01 0.05	**>-0.01 (<0.01)**	**.041**	**>-0.01 -5.98**
Individual planning condition	-0.43 (1.16)	.713	-2.71 1.85	-0.03 (0.03)	.305	-0.10 0.03	0.46 (1.01)	.652	-1.53 2.44	-0.05 (0.03)	.120	-0.11 0.01
Dyadic planning condition	0.26 (1.15)	.820	-2.00 2.52	*-0.05 (0.03)*	*.086*	*-0.12 0.01*	-0.60 (1.01)	.554	-2.59 1.39	*-0.06 (0.03)*	*.083*	*-0.12 0.01*
Collaborative planning condition	-0.54 (1.16)	.641	-2.83 1.74	-0.01 (0.03)	.739	-0.07 0.05	-0.30 (1.03)	.773	-2.32 1.73	-0.03 (0.03)	350	-0.09 0.03
Time x Individual planning condition	<0.01 (0.02)	.988	-0.04 0.04	**<0.01 (<0.01)**	**.014**	**<0.01 <0.01**	-0.02 (0.02)	.249	-0.06 0.02	<0.01 (<0.01)	.739	>-0.01 <0.01
Time x Dyadic planning condition	-0.02 (0.02)	.463	-0.06 0.03	<0.01 (<0.01)	.114	>-0.01 <0.01	**-0.05 (0.02)**	**.010**	**-0.09 -0.01**	<0.01 (<0.01)	.352	>-0.01 <0.01
Time x Collaborative planning condition	<0.01 (0.02)	.982	-0.04 0.04	<0.01 (<0.01)	.647	>-0.01 <0.01	-0.03 (0.02)	.168	-0.07 0.01	5.11 (<0.01)	.961	>-0.01 <0.01
Age	**0.28 (0.02)**	**<.001**	**0.23 0.33**	**>-0.01 (<0.01)**	**.003**	**>-0.01 >-0.01**	**0.26 (0.02)**	**<.001**	**0.21 0.30**	>-0.01 (<0.01)	.534	>-0.01 <0.01
Gender	**-6.03 (0.81)**	**<.001**	**-7.63 -4.43**	0.02 (0.02)	.244	-0.02 0.06	**-9.41 (0.71)**	**<.001**	**-10.82 -8.01**	0.01 (0.02)	.778	-0.03 0.05
MVPA per day at T0	-0.02 (0.01)	.174	-0.04 0.01	<0.01 (<0.01)	.243	>-0.01 >-0.01	-0.01 (0.01)	.227	-0.04 0.01	<0.01 (<0.01)	.304	>-0.01 <0.01
Education	**-0.37 (0.15)**	**.015**	**-0.67 -0.07**	**-0.01 (<0.01)**	**.007**	**-0.02 >-0.01**	**-0.45 (0.14)**	**.002**	**-0.74 -0.17**	**-0.01 (<0.01)**	**.018**	**-0.02 >-0.01**

SES	-0.26 (0.51)	.606	-1.27 0.74	>-0.01 (0.01)	.780	-0.03 0.02	-0.36 (0.45)	.428	-1.24 -0.53	-0.02 (0.01)	.131	-0.05 0.01
Random effects[a]												
Intercept	**50.85** **(4.28)**	**<.001**	**43.12** **59.96**	**0.01** **(<0.01)**	**.018**	**<0.21** **0.02**	**36.82** **(3.43)**	**<.001**	**30.68** **44.19**	**0.02** **(<0.01)**	**<.001**	**0.01** **0.03**
Time	**0.02** **(<0.01)**	**<.001**	**0.01** **0.03**				**0.01** **(<0.01)**	**.043**	**<0.01** **0.02**			
Intercept and time	**-0.31** **(0.08)**	**<.001**	**-0.46** **-0.15**				**-0.12** **(0.06)**	**.057**	**-0.23** **<0.01**			
AR1 rho	**-0.97** **(0.26)**	**<.001**	**-1.00** **1.00**	**0.29** **(0.08)**	**<.001**	**0.12** **0.44**	**-0.41** **(0.20)**	**.037**	**-0.71** **0.03**	0.08 (0.09)	.337	-0.09 0.25

Note. a = for 36-week follow up models: random Time and intercept and fixed effects or only intercept and fixed effects were modelled; 36-week follow-up = change between Time 0 and Time 4 when controlled for Time 3 (9-week follow up); Intercept = baseline respective dependent variable assessment in control condition; Time = change over time in all conditions; Body Fat = body fat percentage; Energy-Dense Food Intake = Energy-Dense Food Index; SES = perceived economic status; Est = estimate; CI_{95} = Lower and Upper levels of 95% Confidence Interval. To model effects over time, a Time variable was included as a predictor, with the following coding: “0” for baseline (T0), “9” for the 9-week follow-up (T3), and “36” for the 36-week follow-up (T4). For sample sizes at each measurement point see Figure S1. Bold coefficients represent significant relationships; MVPA = moderate-to-vigorous physical activity. Coefficients in italics represent statistical trends ($p < .10$). Values <0.01 in the table represent values such as 0.003, but larger than 0. Values > -0.01 in the table represent values such as -0.001 but smaller than 0.

Table S5

Multilevel Model Estimates for Target Persons' and Partners' Body Fat and Controlled for Energy-Dense Food Intake at T0 and T3 Over 36 Weeks in the Respective Planning Conditions and the Control Condition as the Reference Group

Indicators included in model	Target Persons' Body Fat Est *(SE)*	*p*	*CI*95 Lower Upper	Partners' Body Fat Est *(SE)*	*p*	*CI*95 Lower Upper
Fixed effects[a]			36-week follow-up			
Intercept (Control condition)	**32.43 (1.07)**	**<.001**	**30.32 34.55**	**28.21 (1.07)**	**<.001**	**26.11 30.31**
Time	-0.02 (0.02)	.265	-0.05 0.01	0.02 (0.01)	.110	-0.01 0.05
Individual planning condition	-0.46 (1.50)	.758	-3.40 2.48	1.04 (1.48)	.484	-1.88 3.96
Dyadic planning condition	-0.65 (1.49)	.663	-3.57 2.27	-2.33 (1.48)	.116	-5.25 0.58
Collaborative planning condition	-1.32 (1.52)	.385	-4.31 1.67	-0.19 (1.51)	.897	-3.16 2.77
Time x Individual planning condition	2.98 (0.02)	.999	-0.04 0.04	-0.03 (0.02)	.179	-0.07 0.01
Time x Dyadic planning condition	-0.02 (0.02)	.452	-0.06 0.03	**-0.05 (0.02)**	**.007**	**-0.09 -0.01**
Time x Collaborative planning condition	<0.01 (0.02)	.871	-0.04 0.05	-0.03 (0.02)	.120	-0.07 0.01
Energy-Dense Food Intake T0	-1.23 (2.03)	.545	-5.21 2.76	-2.19 (2.56)	.393	-7.23 2.85
Energy-Dense Food Intake T3	-3.81 (3.16)	.228	-10.02 2.40	0.40 (2.28)	.859	-4.07 4.88
Random effects[a]						
Intercept	**85.55 (7.00)**	**<.001**	**72.87 100.44**	**83.71 (6.96)**	**<.001**	**71.11 98.53**
Time	**0.02 (<0.01)**	**<.001**	**0.01 0.03**	**0.01 (<0.01)**	**.009**	**<0.01 0.02**
Intercept and time	**-0.34 (0.09)**	**<.001**	**-0.52 -0.17**	**0.39 (0.03)**	**.003**	**-0.39 -0.08**
AR1 rho	**-0.94 (0.27)**	**<.001**	**-1.00 0.99**	**-0.57 (0.21)**	**.007**	**-0.85 -0.04**

Note. a = for 36-week follow up models: random Time and intercept were modelled; 36-week follow-up = change between Time 0 and Time 4 when controlled for Time 3 (9-week follow up); Intercept = baseline respective dependent variable assessment in control condition; Time = change over time in all conditions; Body Fat = body fat percentage; Energy-Dense Food = Energy-Dense Food Index; Est = estimate; CI_{95} = Lower and Upper levels of 95% Confidence Interval. To model effects over time, a Time variable was included as a predictor, with the following coding: "0" for baseline (T0), "9" for the 9-week follow-up (T3), and "36" for the 36-week follow-up (T4). For sample sizes at each measurement point see Figure S1. Bold coefficients represent significant relationships. Coefficients in italics represent statistical trends ($p < .10$). Values <0.01 in the table represent values such as 0.003, but larger than 0. Values > -0.01 in the table represent values such as -0.001 but smaller than 0.

Table S6

Multilevel Model Estimates for Target Persons' and Partners' Body Fat (Controlled for Energy-Dense Food Intake at T0 and T3 Over 36 Weeks in Any Planning Condition and the Control Condition as the Reference Group

	Target Persons' Body Fat			Partners' Body Fat		
Indicators included in model	Est *(SE)*	*p*	CI_{95} Lower Upper	Est *(SE)*	*p*	CI_{95} Lower Upper
Fixed effects[a]			36-week follow-up			
Intercept (Control condition)	**32.43 (1.07)**	**<.001**	**30.32 34.53**	**28.20 (1.07)**	**<.001**	**26.09 30.32**
Time	-0.02 (0.02)	.261	-0.05 0.01	0.02 (0.01)	.110	-0.01 0.05
Planning condition	-0.79 (1.23)	.519	-3.22 1.63	0.50 (1.23)	.686	-2.93 1.93
Time x Planning condition	>-0.01 (0.02)	.798	-0.04 0.03	**-0.04 (0.02)**	**.021**	**-0.07 -0.01**
Energy-Dense Food Intake T0	-1.31 (2.01)	.515	-5.26 2.64	-2.61 (2.58)	.313	-7.68 2.47
Energy-Dense Food Intake T3	-3.66 (3.13)	.244	-9.83 2.51	0.81 (2.29)	.723	-3.70 5.32
Random effects[a]						
Intercept	**85.12 (6.94)**	**<.001**	**72.54 99.88**	**84.66 (7.02)**	**<.001**	**71.97 99.60**
Time	**0.02 (<0.01)**	**<.001**	**0.01 0.03**	**0.01 (<0.01)**	**.008**	**<0.01 0.02**
Intercept and time	**-0.35 (0.09)**	**<.001**	**-0.52 -0.17**	**-0.22 (0.08)**	**.005**	**-0.38 -0.07**
AR1 rho	**-0.95 (0.26)**	**<.001**	**-1.00 1.00**	**-0.57 (0.21)**	**.007**	**-0.85 -0.03**

Note. a = for 36-week follow up models: random Time and intercept and fixed effects were modelled; 36-week follow-up = change between Time 0 and Time 4 when controlled for Time 3 (9-week follow up); Intercept = baseline respective dependent variable assessment in control condition; Time = change over time in all conditions; Planning condition = any planning condition (collapsing individual, dyadic, and collaborative planning conditions into one group); Body Fat = body fat percentage; Energy-Dense Food Intake = Energy-Dense Food Index; Est = estimate; CI_{95} = Lower and Upper levels of 95% Confidence Interval. To model effects over time, a Time variable was included as a predictor, with the following coding: "0" for baseline (T0), "9" for the 9-week follow-up (T3), and "36" for the 36-week follow-up (T4). For sample sizes at each measurement point see Figure S1. Bold coefficients represent significant relationships. Coefficients in italics represent statistical trends ($p < .10$). Values <0.01 in the table represent values such as 0.003, but larger than 0. Values > -0.01 in the table represent values such as -0.001 but smaller than 0.

Syntaxes for the Main Analyzed Models

Syntaxes for Target Persons' Models of Change Over 36-Week Follow-up

Models for Target Persons' Energy-Dense Food Intake Change Over 36-Week Follow-up

```
  mixed    Pc_DSQ with Time_weeks  ipc dpc cpc
  /print=G  SOLUTION TESTCOV DESCRIPTIVES
  /method=REML
  /fixed=intercept Time_weeks ipc dpc cpc ipc*Time_weeks dpc*Time_weeks
cpc*Time_weeks  | SSTYPE(3)
   /random=  intercept | subject(Pr1_ID) covtype(ID)
/repeated Time_weeks | subject(Pr1_ID) covtype(AR1).


mixed    Pc_DSQ with Time_weeks   Condition_rec
  /print=G  SOLUTION TESTCOV DESCRIPTIVES
  /method=REML
  /fixed=intercept Time_weeks Condition_rec Condition_rec*Time_weeks  | SSTYPE(3)
   /random=  intercept | subject(Pr1_ID) covtype(ID)
/repeated Time_weeks | subject(Pr1_ID) covtype(AR1).
```

Models for Target Persons' Body Fat Change Over 36-Week Follow-up

```
mixed    Pc_FAT  with Time_weeks  ipc dpc cpc
  /print=G  SOLUTION TESTCOV DESCRIPTIVES
  /method=REML
  /fixed=intercept Time_weeks ipc dpc cpc ipc*Time_weeks dpc*Time_weeks
cpc*Time_weeks  | SSTYPE(3)
  /random=  intercept  Time_weeks  | subject(Pr1_ID) covtype(UN)
```

```
/repeated Time_weeks | subject(Pr1_ID) covtype(AR1).


 mixed    Pc_FAT  with Time_weeks   Condition_rec
  /print=G  SOLUTION TESTCOV DESCRIPTIVES
  /method=REML
  /fixed=intercept Time_weeks Condition_rec Condition_rec*Time_weeks  | SSTYPE(3)
  /random= intercept Time_weeks  | subject(Pr1_ID) covtype(UN)
/repeated Time_weeks | subject(Pr1_ID) covtype(AR1).
```

Syntaxes for Partners' Models of Change Over 36-Week Follow-up

Models for Partners' Energy-Dense Food Intake Change Over 36-Week Follow-up

```
   mixed    Pr_DSQ with Time_weeks  ipc dpc cpc
  /print=G  SOLUTION TESTCOV DESCRIPTIVES
  /method=REML
  /fixed=intercept Time_weeks ipc dpc cpc ipc*Time_weeks dpc*Time_weeks
cpc*Time_weeks  | SSTYPE(3)
   /random=  intercept | subject(Pr1_ID) covtype(ID)
/repeated Time_weeks | subject(Pr1_ID) covtype(AR1).


   mixed    Pr_DSQ with Time_weeks  Condition_rec
  /print=G  SOLUTION TESTCOV DESCRIPTIVES
  /method=REML
  /fixed=intercept Time_weeks Condition_rec Condition_rec*Time_weeks  | SSTYPE(3)
   /random=  intercept | subject(Pr1_ID) covtype(ID)
/repeated Time_weeks | subject(Pr1_ID) covtype(AR1).
```

Models for Partners' Body Fat Change Over 36-Week Follow-up

```
mixed     Pr_FAT with Time_weeks  ipc dpc cpc
  /print=G  SOLUTION TESTCOV DESCRIPTIVES
  /method=REML
  /fixed=intercept Time_weeks ipc dpc cpc ipc*Time_weeks dpc*Time_weeks
cpc*Time_weeks  | SSTYPE(3)
  /random= intercept  Time_weeks | subject(Pr1_ID) covtype(UN)
/repeated Time_weeks | subject(Pr1_ID) covtype(AR1).
```

```
mixed     Pr_FAT with Time_weeks  Condition_rec
  /print=G  SOLUTION TESTCOV DESCRIPTIVES
  /method=REML
  /fixed=intercept Time_weeks Condition_rec Condition_rec*Time_weeks  | SSTYPE(3)
  /random=  intercept Time_weeks | subject(Pr1_ID) covtype(UN)
/repeated Time_weeks | subject(Pr1_ID) covtype(AR1).
```

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